Volume 24, Number 16, August 31, 1970

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Division of Technical Information, Edward J. Brunenkant, Director, Published by the USAEC Divison of Technical Information Extension, Robert L. Shannon, Extension Manager.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted:

ISHIHARA, T.
Accumulation of fallout ^{137}Cs in newborn infants, 23:50538
ISHIHARA, Toyokuki
Shielding effect of paraffin, water, soil, concrete, Fe, and Pb for high-energy neutrons, 23:51748

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

MELPHALAN
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MENDELEVIUM
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separation from sodium acetate solutions by solvent extraction using sodium amalgam, 23:49772 (UCRL-18667, pp 277-312)
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Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

51093 (LA-4164) FABRICATION OF BORON CARBIDE RINGS AND DISKS. Sheinberg, H.; Herrera, T.; Kostacopoulos, J. **(Los Alamos Scientific Lab., N. Mex.).** Apr. 25, 1969. Contract W-7405-eng-36. 11p. Dep. CFSTI.

is indexed as:

LOS ALAMOS SCIENTIFIC LAB., N. MEX.
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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 31450 and 33123.

Chemical and Spectral Procedures

Refer also to abstract 31752.

31221 (ARH-SA-55) COULOMETRIC DETERMINATION OF PLUTONIUM IN SOLUTIONS OF DISSOLVED REACTOR FUEL ELEMENTS. Barney, G. S. (Atlantic Richfield Hanford Co., Richland, Wash.). Jan 1970. Contract AT(45-1)-2130. 13p. (CONF-700201-2). Dep. CFSTI.

From 159th National American Chemical Society, Houston, Tex.

Controlled-potential coulometry was applied to the determination of plutonium in complex, highly radioactive mixutres of U, Pu, Np, and fission products that result from the dissolution of reactor fuel elements in nitric acid. It was found that a separation of Pu from fission products was necessary prior to the titration because of the poisoning effect of Zr on the working electrode and the significant concentrations of fission product elements with oxidation potentials close to that of the Pu(III)/Pu(IV) couple. A strongly-basic anion exchange resin containing pyridinium exchange groups was used in small (9-cm × 0.5-cm) columns for the separations. The separation procedure gave better than 99% recovery of Pu and resulted in the elimination of significant concentrations of interfering ions. The measured radiation of the sample was also reduced from an average of 3 r/hr to about 150 mr/hr. Coulometric analysis of 7 Pu samples resulted in a relative standard deviation of ±1.1% at the 95% confidence interval. (auth)

31222 (BNWL-1024) ANALYTICAL CHEMISTRY METHODS IN SUPPORT OF DRIVER FUEL FABRICATION. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 25 Oct 1968. Contract AT(45-1)-1830. 114p. Dep. CFSTI.

Reference analytical methods were compiled to aid in performing routine type chemical analyses required for production of the FFTF driver fuel assembly. Analytical methods are included for determining chemical and physical properties of U- and Pu-bearing ceramic pellets, U- and Pu-bearing feed materials and chemical properties of other pin components. Methods for total Pu, Pu isotopes, total U, U isotopes, impurities, and density, surface area, and particle size measurements are given. (M.C.G.)

31223 (GAMD-10072) SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM IN AQUEOUS SOLUTION. Buzzelli, G. (Gulf General Atomic, Inc., San Diego, Calif.). 13 May 1970. Contract AT(04-3)-633. 16p. Dep. CFSTI.

A method was developed for determination of fission zirconium in solutions of irradiated nuclear fuels. The method is based on measurement of the absorbance of the zirconium complex with Arsenazo III in a strongly acidic aqueous solution. The zirconium is first separated by ion exchange and then determined colorimetrically. (M.C.G.)

31224 (IS-2058) BIBLIOGRAPHY OF MASS SPECTROSCOPY LITERATURE FOR THE LAST HALF OF 1967 COMPILED BY A COMPUTER METHOD. Capellen, J.; Svec, H. J.; Jordan, J. R.; Watkins, W. J. (comps.) (Ames Lab., Iowa). Jun 1970. Contract W-7405-eng-82. 458p. Dep. CFSTI.

This report covers the last half of 1967 and lists 4674 articles of interest to mass spectroscopists. The report consists of three sections; a Bibliography section, an Author Index section, and a Key Word Out of Context Index (KWOC Index) section. The Bibliography section lists the authors, the title, and the source for each article. The Author Index lists the authors' names and the reference numbers of their articles. The KWOC Index lists the key words, the reference numbers of the articles in which the key word appears, and the first 100 characters of the title. (auth)

31225 (LA-4438) X-RAY SPECTROMETRIC DETERMINATION OF RHODIUM AND PALLADIUM IN URANIUM-BASE "FISSIUM" ALLOYS. Hakkila, E. A.; Hurley, R. G.; Waterbury, G. R. (Los Alamos Scientific Lab., N. Mex.). Apr 1970. Contract W-7405-eng-36. 8p. Dep. CFSTI.

Rhodium and palladium in uranium-base "fissium" alloys are measured by x-ray fluorescence spectrometry following separation by hydrolytic precipitation. Samples weighing 200 mg are dissolved in hydrochloric acid and fumed to incipient dryness, and the residue is dissolved in water. Yttrium and iridium are added to serve as an internal standard and as a carrier, respectively, prior to hydrolytic precipitation of rhodium, palladium, yttrium, and iridium using sodium tetrabromate and sodium bicarbonate. The precipitates are digested for 4 hr and collected by filtration on glass-fiber filter disks. The intensities of the Kα x rays for rhodium, palladium, and yttrium, and the $L\alpha_1$ x ray for uranium are measured, rhodium intensity is corrected for uranium overlap, and the rhodium-to-yttrium and palladium-to-yttrium intensity ratios are compared to ratios measured for samples having known compositions which are prepared in a similar manner. The relative standard deviation for measuring between 100 and 1000 μg of rhodium or palladium (0.05 to 0.5%) is between 6 and 1%. Significant interference is not observed in determining either rhodium or palladium in the presence of 0.25% of niobium, 0.5% of zirconium or lanthanum, 1.5% of iron or cesium, or 2.5% of molybdenum, ruthenium, or tungsten. The method was used successfully in determining approximately 0.3% each of rhodium and palladium in "fissium" alloys. (auth)

31226 SOME OBSERVATIONS ON THE CHEMILUMINESCENCE OF ATOMS IN ACETYLENE FLAMES SUPPORTED BY AIR AND ARGON-OXYGEN MIXTURES. Alder, J. F.; Thompson, K. C.; West, T. S. (Imperial Coll. of Science and Tech., London). Anal. Chim. Acta; 50: 383-97(Jun 1970).

A study was made of the chemiluminescent emission of As, Bi, Ca, Cd, Ge, Hg, I, Mo, Pb, Sb, Se, Sn, V, and Zn in the primary combustion zones of air–acetylene and argon–oxygen–acetylene flames, supported at an open burner port during the aspiration of aqueous solutions of their salts. In general, elements having excitation potentials greater than 4 eV show considerably greater atomic chemiluminescence in the primary zone than "thermal" atomic emission in the interconal region. Various mechanisms are suggested for the energy-transfer reactions between metal atoms and excited flame species, particularly carbon monoxide. (auth)

31227 ACCURATE DETERMINATION OF TRACE AMOUNTS OF EUROPIUM IN ALUMINUM. de Bievre, P. J.; Del Bino, G. L. (Central Bureau for Nuclear Measurements, Geel, Belg.). Anal. Chim. Acta; 50: 526-30(Jun 1970).

A mass spectrometric stable isotope dilution method is described for the determination of trace amounts of Eu in Al and Al

alloys. If a large excess of Al is present, the Al is separated by masking with sulfosalicylic acid during extraction of the Eu with TTA. Europium-151 with ~8% ^{153}Eu was used as a spike. The method was applied to both Al and its alloys with an accuracy of 1.3% at the 20 ppM and 4% at the 2 ppM level. (B.L.M.)

31228 ^{131}I MONITORING IN MILK USING AN IODIDE MEMBRANE ELECTRODE FOR CHEMICAL YIELD DETERMINATION. Braun, T.; Ruiz de Pardo, C.; Salazar E., C. (Dept. of Environmental Radioactivity, Lima). Radiochem. Radioanal. Lett.; 3: 397-403(7 May 1970).

A simple and automatizable method for iodide chemical yield determination is based on the use of a Pungor-type iodide membrane electrode. As the procedure uses a comparative electrochemical measurement, the standardization of the iodide carrier solution is unnecessary. (auth)

31229 ISOLATION OF MAGNESIUM FROM BIOLOGICAL MATERIAL FOR MASS-SPECTROMETRIC ISOTOPE ANALYSIS. Stoerl, H. J.; Zahn, H. (Institut fuer Stabile Isotope, Leipzig). Z. Anal. Chem.; 250: 99-101(1970). (In German).

Magnesium is precipitated as hydroxide after elimination of interfering elements by means of ion-exchange procedures (phosphate, iron, trace elements) and masking with EDTA (calcium). The sample is applied in form of $MgCl_2$ to the tungsten filament of an 1-filament-ion-source for surface ionization. (auth)

31230 PHOTOMETRIC DETERMINATION OF ZIRCONIUM USING N-METHYLANABASINE-α'-AZO-3.4-DIMETHYLPHENOL. Rakhmatullaev, K.; Rakmatullaeva, M. A.; Talipov, Sh. T.; Tashmamatov, Kh. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 6, 11-13(1969). (In Russian).

Descriptions are given of a new photometric method for determining zirconium by its reaction with N-methylanabasine-α'-azo-3,4-dimethylphenol. The method of molar ratios and isomolar series indicated that zirconium and the reagent react at a molar ratio of 1:2. The complex compounds followed Beer's law within the concentration limits of 5 to 100 μg in 25 ml solution, with an order of accuracy of 3 to 4%. Tabulated data are given on determination of zirconium (25 μg) in mixed compounds. (R.V.J.)

31231 ANALYSIS OF LIGHT ELEMENTS USING PRIMARY X-RAY BY PROTON EXCITATION. Komada, H. (Tokyo Univ.); Inoue, R.; Terasawa, M.; Gohshi, Y.; Kamei, H.; Fujii, I. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 209-11(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

An x-ray spectrochemical method is described for the determination of light elements (B, C, Be, N, and O) in a nickel-base alloy, low alloy steel, and white iron using proton excitation. Proton beams of 200 keV and 1 to 30 μA were used. It was concluded that the method exhibits high sensitivity (low detectable limit) and little matrix effect, which makes it excellent for analysis in the region of soft x rays. (P.C.H.)

31232 USE OF SOLID STATE DETECTOR IN RADIOISOTOPE X-RAY FLUORESCENCE ANALYSIS FOR URANIUM CONCENTRATION DETERMINATION. Enomoto, Shigemasa; Tominaga, Hiroshi (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 261-3(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A comparison was made on the efficiency of Ge(Li) and Si(Li) detectors for use in the x-ray fluorescence determination of U in powdered ores or aqueous solutions. It was found that a radioisotope source emitting γ rays with an energy about 1.5 times as large as that of the x-rays observed should be selected for samples with trace amounts of U. The results obtained with the Si(Li) detector are given. (P.C.H.)

31233 HYDROXYSTILBENECOMPLEXONE AS A LUMINESCENT REAGENT FOR SCANDIUM. Temkina, V. Ya.; Bozhevolnov, E. A.; Kreingold, S. U.; Yaroshenko, G. F.; Antonov, V. N.; Lastovskii, R. P. (All-Union Scientific-Research Inst. of Chemical Reagents and Specially Pure Chemicals, Moscow). Zh. Anal. Khim.; 25: 894-8(May 1970). (In Russian).

A new fluorescent complexone 3,5-bis[N,N-di(carboxymethyl) aminomethyl]-4,4'-dihydroxystilbene (hydroxystilbenecomplexone) was synthesized and studied. The ionization constants of the reagent are $pK_1 = 2.62$; $pK_2 = 3.83$; $pK_3 = 7.96$; $pK_4 = 9.18$; $pK_5 = 10.52$; and $pK_6 = 11.0$. The fluorescent properties of hydroxystilbenecomplexone were examined. The reagent forms a fluorescent complex with scandium in an acid medium at a ratio of $R:Sc^{3+} = 1:1$. The instability constant of the complex is 1.17×10^{-10}. A method was developed for the luminescent determination of scandium by means of hydroxystilbenecomplexone. The sensitivity is 0.05 μg in 5 ml of solution. (auth)

31234 EXTRACTION OF SCANDIUM WITH BUTYRIC ACID FOR ITS DETERMINATION. Galkina, L. L.; Streltsova, S. A. (Central Asian Scientific-Research Inst. of Geology and Mineral Resources, Tashkent). Zh. Anal. Khim.; 25: 889-93(May 1970). (In Russian).

Scandium can be separated from Fe, Al, Ti, Zr, Be, Nb, Ta, Mo, W, Ca, or Mn by extraction using butyric acid in the presence of sulfosalicylic acid. Scandium is separated from the rare earths (including yttrium) by extraction using solutions of butyric acid in isobutanol at a regulated pH. The composition of the extracted compound was found and the K_{ex} value was calculated. Methods are suggested for determining scandium and the total rare earths from a single sample in silicate ores. (auth)

31235 EXTRACTION OF ACTINIUM AS ITS COMPOUND WITH 1-PHENYL-3-METHYL-4-BENZOYLPYRAZOLONE-5. Karalova, Z. K.; Pyzhova, Z. I.; Rodionova, L. M. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 25: 909-13(May 1970). (In Russian).

Actinium can be quantitatively extracted as its compound with 1-phenyl-3-methyl-4-benzoylpyrazolone-5 by a mixture of benzene and octyl alcohol from solutions with pH 2.6. Extraction of actinium was studied as a function of pH, the reagent concentration, the nature of the solvent, the phase contact time. Conditions were found for separating actinium from radium, thorium, lead, and bismuth isotopes. The yield of actinium is 90%. (auth)

31236 MIXED COMPLEXES OF THE RARE EARTH ELEMENT IONS WITH o-DIHYDROXYCHROMENOLS AND 2-THENOYLTRIFLUOROACETONE AND THEIR USE IN ANALYSIS. Poluektov, N. S.; Sandu, M. A.; Lauer, R. S. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 25: 899-903(May 1970). (In Russian).

Ions of rare earth elements form mixed complex compounds with the reagents of the dihydroxychromenol group with 2-thenoyltrifluoroacetone, which can be extracted with benzene. The composition and properties of the compounds formed were studied. An extraction-photometric method was developed for determining yttrium (or any other element of the yttrium subgroup) in the presence of lanthanum. (auth)

Isotopic Procedures

31237 DETERMINATION OF TRACES OF ARSENIC BY ISOTOPE EXCHANGE REACTION IN THE ORGANIC PHASE. Zeman, A.; Stary, J.; Kratzer, K. (Technical Univ., Prague). Radiochem. Radioanal. Lett.; 4: 1-6(10 May 1970).

A new radioanalytical method for the determination of traces of As (0.1 to 10 μg) has been developed. The method is based on the homogeneous reaction between arsenic(III) – diethyldithiocarbamate and labeled arsenic(III) iodide in carbon tetrachloride. The procedure developed has been applied for the determination of arsenic in sulfuric acid. (auth)

31238 ESTIMATION OF AMINO ACIDS BY AN ISOTOPIC DILUTION PROCEDURE USING THE ENZYMATIC SYNTHESIS OF AMINOACYL TRANSFER RIBONUCLEIC ACID. de Fernandez, Maria Teresa F.; de Sese, Zulema M.; Scornik, Oscar A. (Univ. of Buenos Aires). Biochemistry; 9: 2280-5(26 May 1970).

A new isotopic dilution procedure for the estimation of amino acids, using the enzymatic synthesis of aminoacyl transfer ribonucleic acid (AA-tRNA) is presented. The effect of addition of an unknown amount of cold amino acid (c) on the radioactivity of the AA-tRNA formed is measured upon incubation of a mixture containing a crude source of rat liver enzyme, liver tRNA, adenosine triphosphate (10 mM), magnesium acetate (5 mM), KCl (25 mM), tris-Cl, pH 7.5 (0.1 M), mercaptoethanol (1 mM), a known amount of the amino acid in question labeled with ^{14}C, ^{3}H, or ^{35}S (r) (1 to 2×10^{-4} M), and a mixture of the other unlabeled amino acids. After incubation the AA-tRNA is isolated by acid precipitation followed in some cases by alkaline hydrolysis or by phenol extraction followed by ethanol precipitation and counted. With an incubation volume of 0.1 ml, amounts of 5 to 20 mμ moles are estimated with maximum accuracy. The procedure has been standardized for the determination of leucine, and it is applicable to the L form of the 20 amino acids normally incorporated into protein. Suitable samples should have no effect other than isotopic dilution. This is tested by changing r. When curves are extrapolated to values of r infinitely large no inhibition should be obtained. As an example, the preparation of extracts of rat liver for the measurement of leucine is discussed. (auth)

31239 SEQUENCE ANALYSIS OF COMPLEX PROTEIN MIXTURES BY ISOTOPE DILUTION AND MASS SPECTROMETRY. Fairwell, Thomas; Barnes, William T.; Richards, Frank F.; Lovins, Robert E. (Univ. of Georgia, Athens). Biochemistry; 9: 2260-7(26 May 1970).

A volatile Edman reagent, methylisothiocyanate, is used to degrade sequentially polypeptide mixtures from the N-terminal end. Standard mixtures of ^{15}N-enriched amino acids or their methylthiohydantoin derivatives are added to the reaction. Increase in the $^{14}N:^{15}N$ isotope ratio is observed when ^{14}N amino acid methylthiohydantoins derived from the N-termini of the polypeptide chains dilute the standard mixture. The $^{14}N:^{15}N$ isotopic ratio in the extracted methylthiohydantoin is determined by mass spectrometry. By these means an artificial mixture of polypeptide chains has been shown to have four components; the quantity of each component present has been measured, the amino acid sequence of the N-terminal ten residues has been established for both of the two major sequences present, and the amino acids present at each locus have been determined for the first ten residues of the two minor sequences which were present in equimolecular proportions. This information is obtained simultaneously from a single operation, which is less time consuming and laborious than the analysis of the first ten amino acid residues from a single polypeptide chain by conventional means. The rates of loss of reactive N-terminal groups have been studied when A and B chains of insulin were sequenced simultaneously. The loss rates were 2.5 and 0.9% per residue, respectively. Recovery rates of ^{15}N-labeled methylthiohydantoin amino acids using ^{15}N amino acids or their methylthiohydantoin derivatives established that either may be used for isotope dilution and that losses of the thiazolinone intermediate to compounds other than the methylthiohydantoin derivatives are not quantitatively important. Enolase was shown to have identical sequences for the first eight amino acids from the amino-terminal end in each of the two subunits by this method. (auth)

Radiometric Procedures

Refer also to abstracts 31483, 31505, 31507, 31641–31643, 31679, 31719, and 32002.

31240 (IAN-RS-ERA-5) SEPARATION OF Sr–Ca WITH THE PURPOSE OF CONTROL OF ^{90}Sr IN THE ALIMENTARY CHAIN. Hernandez, J. A.; Gonzalez V., G. (Instituto de Asuntos Nucleares, Bogota (Colombia). Seccion Estudio Radiometrico Ambiental). 1969. 16p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

A method was developed for the separation of Sr from Ca by precipitation of the Ca in the form of calcium potassium ferrocyanide from the oxalates of Ca and Sr obtained for determination of equivalent ^{90}Sr. The method appears advantageous because between 80 and 90% of the Ca can be separated, depending on the Sr concentration. From the same mineralized sample the total β activity, the content in Ca and K, the ^{90}Sr equivalent, and the activity due to ^{90}Sr can be determined. (tr-auth)

31241 (RISO-M-1242) RADIOCHEMICAL PROCEDURES FOR THE DETERMINATION OF PLUTONIUM IN ENVIRONMENTAL SAMPLES. Markussen, Erik Kjaer (Danish Atomic Energy Commission, Risoe. Research Establishment). Apr 1970. 5p. Dep. CFSTI (U. S. Sales Only).

The environmental samples collected during the radioecological studies after the B-52 accident at Thule were analysed for plutonium according to the procedures given. The solid samples were ashed at 600°C, and after the addition of carriers and spikes the ash was melted with potassium pyrosulphate to ensure that all plutonium was in a soluble form before the radiochemical analysis, which was developed especially for this purpose by a combination of an American ion-exchange procedure and a Danish solvent extraction method. After the radiochemical analysis, which could be accomplished within a day for most types of samples, the samples were counted on silicon surface barrier α counters in connection with a multichannel analyser. (auth)

31242 ANALYSIS OF SOME BINARY AND TERNARY OXIDE MIXTURES BY INELASTIC NEUTRON SCATTERING. Pierce, T. B.; Peck, P. F.; Cuff, D. R. A. (Atomic Energy Research Establishment, Harwell, Eng.). J. Radioanal. Chem.; 4: 305-9(Mar 1970).

Aluminum, iron, and silicon were determined in a number of binary and ternary oxide mixtures at levels >1% by measuring the gamma-lines emitted as a result of inelastic neutron scattering. (auth)

31243 TITRATING APPARATUS FOR THE DETECTION OF SOFT β-EMITTING ISOTOPES. Oemboely, Cs.; Szarvas, T.; Vegh, G. (Isotope Inst., Budapest). J. Radioanal. Chem.; 4: 215-22(Mar 1970).

The measuring devices reported in the literature allow only radiometric titrations indicated by hard β or γ-radiating isotopes. An apparatus suitable for the detection of soft β-emitting isotopes was also developed. In the course of the analysis, the activities are measured in a scintillation system in which the great surface of a mass of anthracene crystals provides excellent contact with the active solution. In studies on the linearity of the scintillation system the sources of error and their elimination were also examined. The sensitivity of the scintillation system was determined with ^{3}H, ^{14}C, ^{35}S, ^{45}Ca, ^{36}Cl, and ^{32}P isotopes, frequently applied in organic chemical practice. The method of adjusting the specific activities of reagent solutions prepared from the various isotopes is discussed. The apparatus makes it possible to extend the applications of radiometric titration in the analysis of organic compounds. (auth)

31244 GAS ANALYSIS OF RADIOACTIVE CARBON IN THE FORM OF CARBON DIOXIDE. Seliga, M.; Povinec, P.; Chudy, M. (Komensky Univ., Bratislava). Collect. Czech. Chem. Commun.; 35: 1278-82(Apr 1970).

A procedure is described for the determination of ^{14}C in the atmosphere, which consists of separation of CO_2 from the atmosphere and its introduction into the measuring space of a β-counter. The samples of atmospheric CO_2 were taken in the area of 48°22′ north latitude and 17°35′ east longitude, 1 mile above the earth. The measurements showed that the content of ^{14}C in the atmosphere exceeds the 95% standard NBS. The errors do not exceed 9%. The method makes it possible to measure considerably lower concentrations of ^{14}C than is the maximum permissible limit in the atmosphere. (P.C.H.)

31245 RADIOMETRIC DETERMINATION OF 8-HYDROXYQUINOLINE AND ITS DERIVATIVES WITH CALCIUM CHLORIDE REAGENT SOLUTION LABELLED BY ^{45}Ca. Oemboely, Cs.; Szarvas, T.; Horvath, L. (Isotope Inst., Budapest). J. Radioanal. Chem.; 4: 223-8(Mar 1970).

Radiometric titrations are reported based on the formation of poorly soluble chelate complexes of 8-hydroxyquinoline and its derivatives with calcium ions. Calcium chloride reagent solution labeled with ^{45}Ca was used for the titrations. The slightly alkaline medium used in the titrations made complete the solution of the substances and the formation of chelate complexes. The appropriate conditions of the titrations of the various compounds have been determined. The radiometric titrations were carried out in an apparatus suitable for the detection of soft β-emitting isotopes. (auth)

31246 STUDIES ON THE MEASUREMENT OF THE HEAVY WATER CONCENTRATION BY THE APPLICATION OF FAST NEUTRONS SLOWING DOWN METHOD. Tone, Hirohito (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 123-5(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies on the use of the fast neutron slowing down method for the determination of heavy water concentration in heavy water moderated reactors showed that the method is useful for continuous determination. If small amounts of neutron absorbers with large neutron cross section or voids are present in heavy water, the determination of heavy water concentration is only slightly affected. (P.C.H.)

31247 ANALYSIS OF MEDIUM WEIGHT ELEMENTS BY RI X-RAY SPECTROMETER USING Si(Li) DETECTOR. Tanemura, Takashi; Suita, Hiroshi (Rigaku Denki Co., Ltd., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 212-14(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The usefulness of the formula for the theoretical relation between fluorescent x-ray intensity and concentration in radioisotope x-ray analysis of medium weight elements is discussed. The materials analyzed were $AgNO_3-Cd(CH_3CO_2)_2$, and Fe_2O_3-NiO. The results agreed well with experimental values. (P.C.H.)

31248 APPLICATION OF RADIOGASCHROMATOGRAPHY TO AGRICULTURE AND BIOLOGY. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 907-32(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The use of radio-gas chromatography in the analysis of ^{32}P-labeled compounds, ^{131}I- or ^{128}I-labeled alkyl iodides, and ^{14}C- and/or ^{3}H-labeled compounds is reported. The characteristics of scintillation-type radioisotope detectors are given. (D.H.M.)

31249 GROWTH AND DECAY TABLES FOR ^{225}Ra AND ^{225}Ac. Smith, K. A.; Bartlett, B. O. (Agricultural Research Council Letcombe Lab., Wantage, Eng.). J. Radioanal. Chem.; 4: 383-9(Mar 1970).

To facilitate the use of ^{225}Ra as a yield tracer in radiochemical assays of ^{226}Ra and ^{228}Ra, growth and decay tables for ^{225}Ra, and its daughter ^{225}Ac, have been computed. (auth)

31250 RAPID DETERMINATION OF ^{235}U CONTENTS OF URANIUM SAMPLES UTILIZING HIGH RESOLUTION Ge(Li) DETECTOR. Chung, M. K.; Cho, S. W.; Suh, D. W. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 1: 33-8 (Sep 1969). (In Korean).

Determinations of the isotopic contents of ^{235}U and ^{238}U in ten uranium samples containing 0.72 to 89.70 at. % ^{235}U were carried out in two ways utilizing a high-resolution Ge(Li) gamma spectrometer. One method is based on the fact that the intensity of the 185.5-keV gamma ray varies linearly with ^{235}U content for a given geometry. Another method applied for the direct determination of the $^{235}U/^{238}U$ isotopic ratios is the precision gamma spectrometric analysis of reactor-irradiated uranium samples after allowing a fixed cooling time for one hour. The results obtained by both methods well agree with the values calculated from the isotopic contents of highly enriched original uranium samples measured by mass spectrometer. The precision obtained was well below 5% for most of the isotopic ratios investigated. (auth)

31251 ANALYSIS OF PLANETARY SURFACES USING ALPHA PARTICLES. Franzgrote, E. J. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc.; 13: 54(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31252 NONDESTRUCTIVE MEASUREMENT OF RADIONUCLIDES IN APOLLO 11 SAMPLES. Perkins, R. W.; Ranciteli, L. A.; Cooper, J. A.; Kaye, J. H.; Wogman, N. A. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 55-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31253 BORON AND URANIUM DETERMINATION IN SIMULATED LUNAR GLASS BY THE NUCLEAR TRACT TECHNIQUE. Carpenter, B. S. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 79(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31254 APPLICATION OF Sb-Be NEUTRON SOURCE FOR NONDESTRUCTIVE FUEL ASSAY. Gozani, T. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 319-20(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Activation Procedures

Refer also to abstracts 31362, 31364, 31469, 31913, 31981, 32084, and 32529.

31255 (JUL-559-ME) γ SPECTRA OF ELEMENTS OCCURRING IN ORGANISMS AFTER ACTIVATION WITH THERMAL (REACTOR) NEUTRONS ENTERED ACCORDING TO DECAY TIME. Siller, V.; Kasperek, K. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Medizin). Sep 1969. 195p. (In German). Dep. CFSTI (U. S. Sales Only).

The elementary spectra of elements occurring in biological materials after thermal neutron activation were determined. The preparation of the samples and their irradiation in the FRJ I and FRJ II reactors are described. The technique for obtaining the spectra is outlined. The γ spectra were obtained and given for the following elements: Ag, Al, As, Ba, Br, Ca, Cd, Ce, Cl, Co, Cr, Cs, Cu, Eu, Fe, Ga, Gd, Hf, Hg, In, Ir, I, and K. (J.S.R.)

31256 (RLO-2062-6) NEUTRON ACTIVATION ANALYSIS FOR CORRELATING VOLCANIC ASH SOILS. Borchardt, Glenn Arnold (Oregon State Univ., Corvallis). Jun 1970. Contract AT(45-1)-2062. 219p. Dep. CFSTI.

Thesis.

The objectives of this study were: to determine trace element differences between sample sites and between deposits of Mazama, Newberry, Glacier Peak, and St. Helens volcanic ash in the Pacific Northwest; to correlate volcanic ash in peat bogs with volcanic ash from upland sites; to verify Mazama ash as parent material of soils occurring along a 450 km transect in Oregon; and to determine the trace element composition of clays derived from volcanic ash. Samples were irradiated in a TRIGA Reactor, followed by detection of elements with a high-resolution 30-cc Ge(Li) semiconductor detector and a 4096-multichannel analyzer. Gamma spectra were analyzed with a computer program. Field variability of Mazama and Newberry ash deposits in Oregon was about 5%, whereas the variability of the crystal-rich Glacier Peak and St. Helens ash of Washington was greater. The trace element compositions of volcanic glass from C horizons of soils along a 450-km transect in Oregon correlate with ejecta from Mt. Mazama. Enrichment and leaching effects in weathered horizons interfere with correlations that use variation analysis. Weathering in soils developed on volcanic ash resulted in enrichment of trace elements in sand-size volcanic glass. An attempt to correlate clays from different volcanic ash layers revealed chemical similarities between soil clays from Glacier Peak and Mazama ash and lapilli, but the chemical composition was different for soil clays formed on Newberry lapilli. (auth)

31257 AUTOMATED IDENTIFICATION OF ISOTOPES IN NEUTRON ACTIVATED SAMPLES. Dams, R.; Adams, F. (Ghent Univ.). J. Radioanal. Chem.; 4: 311-23(Mar 1970).

A tabulation of about 2000 precise gamma energies of about 250 isotopes formed through neutron activation has been used for the computer-assisted identification of the individual gamma emitters in complex gamma spectra. The identification consists in the calculation of the gamma energies from the peak maximum position by taking into account the deviation from linearity of the spectrometer. Successive comparison of these energies with the energies of the tabulation allows them identification. The identification procedure was tested on a number of samples of varying complexity and satisfactory results were obtained. (auth)

31258 DETERMINATION OF IMPURITIES IN MARBLES FROM DIFFERENT DEPOSITS IN YUGOSLAVIA BY ACTIVATION ANALYSIS. Draskovic, R. J.; Draskovic, R. S. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). J. Radioanal. Chem.; 4: 299-303(Mar 1970).

Impurities in marbles from the deposits in Petrovac na Mlavi, near Gostivar (Duf and Sušički Most) and Venčac in Yugoslavia have been determined by activation analysis. The impurities of Na, Mn, and Cu were determined from the characteristic photopeaks with γ energies of 1.38 and 2.78 MeV (^{24}Na); 0.511 MeV (^{64}Cu) and 0.850 MeV (^{56}Mn), and from the corresponding half-lives of these radioisotopes. The concentrations of Mn, Na, and Cu were also determined in every marble sample. (auth)

31259 DETERMINATION OF RARE EARTHS IN RARE-EARTH CONCENTRATES BY NEUTRON ACTIVATION ANALYSIS. Van den Bergh, F.; Adams, F.; Hoste, J. (Ghent Univ.). J. Radioanal. Chem.; 4: 347-53(Mar 1970).

Neutron activation analysis was applied to the determination of La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Yb, Lu, and Th in rare-earth concentrates resulting from minerals. High-resolution gamma spectrometry with a Ge(Li) detector was used for the nondestructive determination, and a single comparator method using Co as flux monitor was applied. (auth)

31260 ELIMINATION OF POTASSIUM ACTIVITY IN ACTIVATION ANALYSIS BY ISOTOPIC EXCHANGE ON COLUMNS. Massart, D. L. (Vrije Univ., Brussels). J. Radioanal. Chem.; 4: 265-70(Mar 1970).

The possibility of the elimination of ^{42}K-activity by isotopic exchange in columns was investigated with several potassium salts as the stationary phase. A method using potassium phosphotungstate is described and examples are given. (auth)

31261 APPLICATION OF THE GROUP SUBSTOICHIOMETRIC SEPARATION OF GOLD, MERCURIC, AND CUPRIC DIETHYLDITHIOCARBAMATES TO DETERMINING THEM BY MEANS OF ACTIVATION ANALYSIS. Kukula, F.; Simkova, M. (Nuclear Research Inst., Rez, Czech.). J. Radioanal. Chem.; 4: 271-9(Mar 1970).

The substoichiometric method has been applied to group separation. By a single extraction gold and mercury were separated quantitatively, and copper substoichiometrically, at the same time. Zinc diethyldithiocarbamate has been used as the chelating agent. The group of elements was separated from 2N H_2SO_4 and 0.1N $HClO_4$ medium. This method of group separation was applied to the activation analysis of biological materials and metallic tin. (auth)

31262 SUBSTOICHIOMETRY FOR MULTIELEMENT SEPARATION BY METAL CHELATE EXTRACTION AND ITS APPLICATION IN ACTIVATION ANALYSIS. I. PRINCIPLE AND THEORY OF THE METHOD. Elek, A.; Bogancs, J.; Szabo, E. (Central Research Inst. for Physics, Budapest). J. Radioanal. Chem.; 4: 281-8(Mar 1970).

The method of substoichiometric separation was completed for radioactivity measurements using special nuclear measurement methods in a way that along with the substoichiometric extraction of a given metal the simultaneous quantitative separation of other metals can also be effected. Some general relationships have been derived for the substoichiometric multielement separation of MA_m-type metal chelates. Particularly, the primary dithizonates of silver and copper(II) have been studied, and the application of the method is demonstrated by the separation of silver and copper from cobalt. (auth)

31263 SELECTIVE REMOVAL OF ^{32}P FROM ACTIVATED SPECIMENS IN NEUTRON ACTIVATION ANALYSIS. Sabbioni, E.; Pietra, R.; Girardi, F. (Joint Nuclear Research Center, Ispra, Italy). J. Radioanal. Chem.; 4: 289-97(Mar 1970).

The presence of large quantities of ^{32}P in neutron-activated biological specimens is often a limiting factor in the direct application of γ spectroscopy. A technique for the selective removal of phosphates in neutron activated specimens is described. The technique is based on the adsorption of phosphates on chromatographic grade alumina. The adsorption selectivity was studied by determining the behavior of 49 ions when submitted to the procedure for phosphate removal. A few applications are reported as examples. (auth)

31264 NEUTRON ACTIVATION ANALYSIS DETERMINATION OF ALL 14 STABLE RARE EARTH ELEMENTS WITH GROUP SEPARATION AND Ge(Li) SPECTROMETRY. Graber, F. M.; Lukens, H. R.; MacKenzie, J. K. (Gulf General Atomic Inc., San Diego, Calif.). J. Radioanal. Chem.; 4: 229-39(Mar 1970).

A lithium-drifted germanium detector, 40 cm^3, combined with a radiochemical group separation, has been utilized to determine the concentrations of 14 stable rare earth elements in a silicate rock sample, following thermal neutron activation. Thirteen rare earths could be determined within a 8-day decay period. The remaining rare-earth element (Tm) required a longer delay, and subtraction of the interfering contribution from ^{160}Tb. Samples of standard rock G-1 and W-1 were also analyzed by this procedure for 13 rare earth elements, results of which are compared with literature values. (auth)

31265 AN ACTIVATION ANALYSIS TECHNIQUE FOR DETERMINING GROUPS OF TRACE ELEMENTS IN ROCKS AND CHONDRITES. Laul, J. C.; Case, D. R.; Wechter, M.; Schmidt-Bleek, F.; Lipschutz, M. E. (Purdue Univ., Lafayette, Ind.). J. Radioanal. Chem.; 4: 241-64(Mar 1970).

A thermal neutron activation analysis technique has been developed for the analysis of terrestrial rocks and stony meteorites for trace elements. The main emphasis of the method is directed toward minimizing chemical procedures and maximizing the use of Ge(Li) gamma spectroscopy and computer data reduction. The validity of the technique is demonstrated by presenting data obtained for synthetic samples, U.S.G.S. Standard Rocks and three ordinary chondrite meteorites for the following elements: As, Au, Co, Cs, Ga, Ge, Hg, Mo, Os, Re, Sb, Sc, Se, Te, and Zn. (auth)

31266 DETERMINATION OF ARSENIC IN GERMANIUM BY THE COMBINATION OF ISOTOPE DILUTION AND ACTIVATION ANALYSIS. Lima, F. W.; Silva, C. M. (Instituto de Energia Atomica, Sao Paulo, Brazil). J. Radioanal. Chem.; 4: 197-205(Mar 1970).

The determination of arsenic by activation analysis in germanium may be disturbed by arsenic isotopes formed in the irradiation of the germanium matrix itself. The isotopic dilution technique will eliminate such interferences, but it requires weighing of very small masses of arsenic, after appropriate chemical separation. This weighing procedure can be avoided if the mass of the recovered arsenic is determined by activation analysis. In order to apply such a procedure, a known amount of arsenic labeled with ^{76}As, whose specific activity is also known, is added to the germanium sample to be analyzed. The sample is processed, the arsenic separated, and the chemical yield established. The recovered mass of arsenic is then determined by activation analysis applying the classical isotopic dilution analysis formula. The accuracy precision and linearity of the method are discussed. (auth)

31267 DECAY SCHEME FROM NEUTRON ACTIVATION DETERMINATION OF HAFNIUM AND SPECTRA OF ^{178}Lu. Balsenc, L.; Beeler, R.; Monnier, D. (Univ., Geneva). J. Radioanal. Chem.; 4: 187-95(Mar 1970). (In French).

A partial decay-scheme is proposed for ^{178m}Lu in order to fit with experimental observation. A transition between the isomeric state and the ground-state of ^{178}Lu is suggested. This hypothesis is proved mathematically. (auth)

31268 ACTIVATION ANALYSIS OF SOILS FOR DETERMINATION OF MAGNESIUM. Fierotti, Giovanni (Univ., Palermo, Italy); Cappadona, Carmelo. pp 145-55 of Applicazioni dell'-Energia Nucleare in Agricoltura. Roma; Comitato Nazionale Energia Nucleare (1968). (In Italian).

From Applications of Nuclear Energy in Agriculture Conference, Palermo, Italy. See CONF-670558.

An easy rapid method is given for the determination of Mg in soils by means of neutron activation of the soil in Cd coverings with a modest neutron flux and measurement of the total β activity resulting. (tr-auth)

31269 PRODUCTION RATES OF RARE EARTH NUCLIDES BY 70-MeV BREMSSTRAHLUNG FOR PHOTON ACTIVATION ANALYSIS. Kato, T.; Voigt, A. F. (Ames Lab., Iowa). J. Radioanal. Chem.; 4: 325-35(Mar 1970).

The combination of photon activation and solid state γ-ray detection provides a very effective method for analysis of rare earths. The production rates of almost all of the product nuclides found in yttrium and 14 rare earths irradiated with 70-MeV bremsstrahlung protons from an electron synchrotron are described. A 20 cm^3 lithium-drifted germanium diode was used as a detector. Sensitivities of this method have been summarized for photon activation analysis, and experimental reaction yields have been obtained in order to discuss the reactivity of high-energy photons with nuclei in the rare earth region. (auth)

31270 EXPERIENCES WITH THE LEAST-SQUARES ANALYSIS OF γ-RAY SPECTRA OF NUCLIDE MIXTURES AND THE SIMULTANEOUS DETERMINATION OF LONG-LIVED RADIONUCLIDES IN NEUTRON-ACTIVATED LEAD AND ALUMINUM. Erdtmann, G.; Freiburg, C.; Petri, H. (Kernforschunganlage, Juelich, Ger.). Z. Anal. Chem.; 250: 1-12(1970). (In German).

Gamma spectra from artificial mixtures of up to 17 various radionuclides as well as γ spectra from neutron-activated samples of lead and aluminum were recorded by NaI(Tl) and Ge(Li) γ spectrometers and analyzed by comparison with standard spectra of the composing radionuclides. The evaluation was carried out by a least squares procedure using an IBM-360/75 computer. Recording of the γ spectra was done with and without digital spectrum stabilization. The evaluation program offered the optional subprograms "Gainshift Correction" and "Input and Elimination of Supernumerary Standard Spectra." Results from the various combinations of these different recording and evaluating techniques are discussed. In order to have an independent reference figure for comparison and estimation of the results an "ideal mean standard deviation" was defined. The examples presented show the applicabilities as well as the limitations of this procedure for the simultaneous determination of several radionuclides by means of the computer programs. (auth)

31271 NONDESTRUCTIVE DETERMINATION OF ELEMENTS BY PROMPT GAMMA RAY SPECTROMETRY USING ^{241}Am–Be NEUTRON SOURCE. Kusaka, Yuzuru; Tsuji, Haruo (Konan Univ., Kobe City, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 66-8(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the use of an Am–Be source for the determination of various elements by thermal neutron activation and prompt γ spectrometry. Gd, B, Sm, Eu, Cd, Dy, Hg, In, Co, Ag, and Mn were determined in oxide powders and Cl was determined in various organic compounds, such as 2-chloroethanol, chlorobenzene, o-chloroaniline, chloroform, and p-chlorobenzoic acid. The results showed that the complexity and low detection efficiency of the high energy (>3 MeV) γ rays in the spectra of the first 12 elements made it difficult to perform satisfactory analyses. In the organic samples the method was applicable for the Cl content of 5 to 50 wt/v %, and the experimental values found coincided with theoretical ones. It was concluded that the method could be improved with the use of a stronger neutron source. (P.C.H.)

31272 DETERMINATION OF COPPER, ARSENIC, AND MERCURY IN PLANT BY ACTIVATION ANALYSIS. Maruyama, Yoshiaki; Komiya, Kazuhide; Manri, Teruo (Musashi Inst. of Tech., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 69-71 (1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A method is described for the determination of Cu, As, and Hg, in tobacco leaves by neutron activation, extraction in concentrated HCl or HNO_3, and counting with a 400-channel pulse height analyzer. (P.C.H.)

31273 DETERMINATION OF CHLORINE AND BROMINE IN PLANT BY ACTIVATION ANALYSIS. Maruyama, Yoshiaki;

Manri, Teruo; Komiya, Kazuhide (Musashi Inst. of Tech., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 72-4(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Bromine and chlorine were determined in potatoes by neutron activation followed by shaking for 2 min with 15 ml of distilled water, 0.1 N NaOH solution, or 1 N HNO_3. The radioactivities of ^{38}Cl and ^{82}Br were counted with a 400-channel pulse height analyzer with a $1\frac{3}{4}'' \times 2''$ NaI(Tl) crystal. In this way, the destruction of plants, which is often time-consuming and prevents the determination of short-lived nuclides and the treatment of a number of samples, is avoided. (P.C.H.)

31274 MEASUREMENT OF TRACE ELEMENTS IN THE HUMAN LIVER BY NEUTRON ACTIVATION ANALYSIS: BROMINE AND IODINE. Nagao, Hiroyuki (Nippon Atomic Industry Group Co., Ltd., Kawasaki, Japan); Tani, Akira; Iwase, Tohru; Iio, Masahiro. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 75-7(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A method is described for the determination of Br and I in human liver samples by neutron activation, simultaneous separation as one group, and γ spectrometry. The overall time required for the separation is not more than 7 min and the chemical losses for Br and I are not more than 10%. (P.C.H.)

31275 NONDESTRUCTIVE PHOTOACTIVATION ANALYSIS OF Cd, Ba, AND Pb IN PVC SHEETS. Kondo, Yoshihide (Kinki Univ., Osaka); Miki, Ryota; Azuma, Toshio. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 78-80(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A method is described for the determination of the additives, Ba, Cd, and Pb, in poly(vinyl chloride) (PVC) sheets by bremsstrahlung activation and γ spectrometry. Standard sheets containing known amounts of Ba, Cd, and Pb were used to obtain calibration curves. (P.C.H.)

31276 DETERMINATION OF OXYGEN IN HIGH MELTING POINT MATERIALS BY FAST NEUTRON ACTIVATION. Muto, Haruo; Gohshi, Yohichi (Tokyo Shibaura Electric Co., Ltd.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 107-9(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A method is described for the determination of oxygen in high-melting-point materials, such as $MoSi_2$, TaC, $SiC-Si_3N_4$, WC–TiC, Nb, WC–TiC–Co, and WC–Co, by fast neutron activation and γ spectrometry. The WC–TiC–Co and WC–Co were block samples and the others were powder samples. It was found that the oxygen content of the powder samples was higher than that of the block samples. The standard deviations at the 0.1 and 0.001% oxygen concentration were 5 and 40%, respectively. The time required for analyzing one sample was about 2 min. (P.C.H.)

31277 DETERMINATION OF OXYGEN IN STEEL BY NEUTRON ACTIVATION ANALYSIS. Miyagawa, Kazuo; Ichijima, Isamu; Asai, Akira; Nomura, Etsuo; Mishima, Isamu (Fuji Iron and Steel Co., Ltd., Hirohata, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 110-12(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A method is described for the determination of oxygen in steel by 14-MeV neutron activation and γ spectrometry. The method was developed in order to overcome the difficulties of the conventional vacuum fusion method. A pneumatic system was used for rapid transport of the sample from the target area to the detector. Only 4 min was required for each determination. (P.C.H.)

31278 ACTIVATION ANALYSIS OF VARIOUS MATERIALS RELATED TO THE "YUSHO" (CHLORBIPHENYL POISIONING). Yamada, Yoshio (Kyushu Univ., Fukuoka); Miyaguchi, Masao; Iwata, Shiro; Tamai, Chuji; Uehara, Shinichi; Takeuchi, Takayuki. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 439-41(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Several hundred people who used rice oil for cooking suffered from poisoning in the western district of Japan in 1968. The poisoning was named "Yusho." Neutron activation analysis of various materials, such as hair, nails, chlorobiphenyl, which was a heat medium in the refining process, and dark oil, which was considered to be closely related to the Yusho, was used in attempts to determine the cause of poisoning. Data on the contents of Na, Cl, and Br in the samples are tabulated. No heavy metals were found in the oils. It was concluded that the organic chlorine in the oils might be the cause of Yusho. (P.C.H.)

31279 RECENT DEVELOPMENTS IN THE ACTIVATION ANALYSIS IN JAPAN. Hamaguchi, Hiroshi (Tokyo Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 516-23(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Recent developments in the application of activation analysis in various fields since 1964 are reviewed. (P.C.H.)

31280 SPECIAL CONSIDERATIONS IN THE LARGE SCALE ANALYSIS OF BIOMEDICAL SAMPLES BY AUTOMATED NUCLEAR ACTIVATION METHODS. Wainerdi, Richard E.; Yule, Herbert P.; Fite, Lloyd E. (Texas A and M Univ., College Station). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 524-34 (1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A review is presented on the development of equipment and computer programs for activation analysis. Methods for the avoidance of sodium interference in biomedical samples, and the lack of comparison standards for many elements in biological systems are discussed. It was concluded that activation analysis appears to be a promising method for elucidating information on the role of trace elements in health and nutrition if the problem inherent in large-sample biomedical analyses can be overcome. (P.C.H.)

31281 ACTIVATION ANALYSIS: PRESENT STATUS AND FUTURE POTENTIAL. Meinke, W. Wayne (National Bureau of Standards, Washington, D. C.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 535-7(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The present status of activation analysis is discussed with particular reference given to the way it compares today with other methods of analysis. Although activation analysis is used routinely by many in the world today, it is still considered to be a specialty method. The future of activation analysis is described as favorable because of accuracy, the fact that it is seldom encumbered with the severe matrix effects of emission spectroscopy, and it is not subjected to the major instrument biases of mass spectrometry. It was concluded that activation analysis will be of most assistance when it is used in conjunction with other typical trace methods such as polarography, emission spectroscopy, atomic absorption, etc., as part of a Trace Characterization Laboratory. (P.C.H.)

31282 RECENT DEVELOPMENTS IN FORENSIC ACTIVATION ANALYSIS APPLICATIONS. Jervis, R. E. (Univ. of Toronto). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 547-8 (1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The advantages of activation analysis in forensic science are discussed along with recent developments, which include the use of high resolution γ spectrometry with Ge(Li) detectors to facilitate multi-element nondestructive analyses for trace element comparisons, the development of techniques for detecting the transference of submicrogram quantities of ballistic materials, the introduction of activatable marker elements to facilitate the subsequent identification of materials, and the highlighting of public health hazards due to environmental pollution by trace analysis of representative samples from the biosphere and food chains. Several projects currently underway in forensic activation analysis are mentioned. (P.C.H.)

31283 PRESENT STATUS OF ISOTOPE APPLICATIONS IN JAPANESE INDUSTRY. Kato, M. (Tokyo Univ.); Kobayashi, M.; Ohno, A.; Nagumo, T.; Takano, K.; Iijima, H.; Ohno, H.; Goto, M. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 552-9(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A review is presented on the recent progress in industrial isotope techniques and significant applications carried out in various industrial fields. The review is limited to works published since 1967. The uses discussed include those in gages, instrumental analysis, radiography, activation analysis, tracer techniques, heat and power sources, metal industry, machinery and electrical industries, civil engineering, and the chemical industry. (P.C.H.)

31284 KRIS: A COMPUTER PROGRAM FOR THE LEAST-SQUARES RESOLUTION OF GAMMA-RAY SPECTRA BY HALF-LIFE AND GAMMA-RAY ENERGY. Hoffman, B. W.; Wainerdi, R. E. (Texas A and M Univ., College Station). J. Radioanal. Chem.; 4: 375-82(Mar 1970).

KRIS offers the capability of resolving complex γ spectra, even when spectra of the individual components are quite similar. A scheme is employed which allows for the use of half-lives as well as γ energies in the least-squares resolution of γ spectra. Options are also supplied for averaging of repetitive counts, least-squares smoothing of the data, iterative improvement of the weighting factors used in the least-squares solution, and use of either live or clock time counts. The number of control cards required for each sample has been minimized to simplify input. KRIS is written in FORTRAN IV and is being run under Fortran G and the Watfor compiler on the IBM-360/65. (auth)

31285 NEUTRON ACTIVATION ANALYSIS IN MEDICINE. Altmann, H. (Reaktorzentrum, Seibersdorf, Austria). Wien. Tieraerztl. Monatsschr.; 54: 756-63(Nov 1967). (In German).

Applications and examples of the use of neutron activation analysis procedures in veterinary, human, and legal medicine were reviewed. These included studies of the mechanism of radiation protection, reduction of irradiation doses in patients, sensitization of tumors to irradiation, metal toxicity studies, trace element metabolism, enzyme activity, effects of irradiation and hyperbaric O_2, and composition of tissues. The detection sensitivity of neutron activation analysis and its relation to radioisotopic analysis were discussed briefly. 40 references. (BBB)

31286 INVESTIGATION OF UNDERGROUND WATER IN THE SAHARA. III. IDENTIFICATION OF SOME TRACE ELEMENTS BY NEUTRON ACTIVATION ANALYSIS. Hazzaa, I. B.; Abdel-Rassoul, A. A.; Eskangi, A. M.; Ghattas, N. K. (Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo). Isotope Radiat. Res.; 2: 9-15(Jun 1969).

Radiochemical methods were developed for the simultaneous determination of silver, chromium, cobalt, iron, zinc, and cadmium in a number of underground waters collected from different localities in the Sahara. The scheme developed is principally based on mutual separation of the elements by ion exchange elution chromatography followed by chemical precipitation of the respective radioactive preparations for appropriate radiochemical assay. The role of trace elements for intercorrelation of different waters is discussed. Some similarities in the nature and distribution of the detected trace elements in different water resources from the same geological formation were observed. (auth)

31287 MULTIELEMENT ANALYSIS OF LUNAR SAMPLES USING NEUTRON ACTIVATION AND SPARK SOURCE MASS SPECTROSCOPY. Morrison, G. H. (Cornell Univ., Ithaca, N. Y.). Trans. Amer. Nucl. Soc.; 13: 54-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31288 ANALYSIS OF METAL SURFACES FOR RESIDUAL GRAINS OF POLISHING COMPOUND. Butler, J. W.; Wolicki, E. A.; Bernett, Marianne K. (Naval Research Lab., Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 57-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31289 DETECTION OF CHLORINE BY CHARGED-PARTICLE-INDUCED REACTIONS. Knudson, A. R.; Dunning, K. L. (Naval Research Lab., Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 57-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31290 TRACE DETERMINATION OF LEAD USING PROTON AND DEUTERON ACTIVATION ANALYSIS. Schweikert, E. A. (Texas A and M Univ., College Station). Trans. Amer. Nucl. Soc.; 13: 58-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31291 RADIOACTIVITY MONITORS AND ACCURACY IN PHOTONUCLEAR EXPERIMENTS. Currie, Lloyd A. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 59(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31292 SIMULTANEOUS DETERMINATION OF CARBON AND OXYGEN IN ELECTROPLATED GOLD BY ^3He ION BOMBARDMENT. Kim, C. K.; Vasile, M. J. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Trans. Amer. Nucl. Soc.; 13: 60(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31293 NEUTRON CAPTURE GAMMA-RAY ANALYSIS OF MARINE MANGANESE NODULES USING ^{252}Cf. Wiggins, P. F. (Naval Academy, Annapolis, Md.).; Senftle, F. E.; Duffey, Dick. Trans. Amer. Nucl. Soc.; 13: 60-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31294 ^{252}Cf NEUTRON SOURCE FOR LABORATORY AND POSSIBLE IN SITU MINERAL ANALYSIS. Perkins, R. W.; Rancitelli, L. A.; Cooper, J. A.; Brown, R. E. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 63-4 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31295 DETERMINATION OF PULSE PILEUP AND NUCLEAR INTERFERENCES IN 14-MeV NEUTRON ACTIVATION ANALYSIS FOR TRACE OXYGEN. Nargolwalla, S. S.; Suddueth, J. E.; Rook, Harry L. (National Bureau of Standards, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 78-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31296 IN VIVO ACTIVATION ANALYSIS FOR CALCIUM: PRELIMINARY EXPERIMENTS AT MITR. Maccabee, H. D.; Schlenker, R. A.; Brownell, G. L. (Massachusetts Inst. of Tech., Cambridge). Trans. Amer. Nucl. Soc.; 13: 80-1(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31297 NUCLEAR MATERIAL ASSAYS USING TOTAL GAMMA-RAY YIELDS FROM LOW-ENERGY NEUTRON RESONANCES. Carlson, A. D.; Friesenhahn, S. J.; Fricke, M. P.; Lopez, W. M.; Bramblett, R. L. (Gulf General Atomics Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 318-19(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31298 ON THE POSSIBILITY OF ESTABLISHING THE STOICHIOMETRIC RATIOS BY THE RADIOACTIVATION METHOD. Zadvorni, A. S.; Gorenko, A. F.; Skakun, N. A. (Physical-Technical Inst., Kharkov). Zh. Anal. Khim.; 25: 867-9(May 1970). (In Russian).

A comparison was made of the content of carbon and oxygen atoms per unit of volume of substances similar in their structure. At the same amount of hydrogen no deviation from stoichiometry for Lavsan ($(C_{15}H_{12}O_6)_n$) and its analog Mailar was observed. At a proton flux of 0.02 μA the sensitivity for carbon and oxygen is respectively 10^{-3} and 10^{-2}% (weight). The statistical measurement error is not higher than ±5%. (auth)

31299 PRECISION AND ACCURACY OF RARE EARTH DETERMINATIONS IN ROCK SAMPLES USING INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS AND A Ge(Li) DETECTOR. Melsom, S. (Central Inst. for Industrial Research, Blindern, Norway). J. Radioanal. Chem.; 4: 355-63(Mar 1970).

Some of the rare earth elements have been determined in U.S.G.S. Standard Rocks W1 and G2 using instrumental neutron activation analysis with a Ge(Li) detector. The experimental conditions were chosen to investigate the precision and accuracy to be expected when using the method for routine purposes. The results are compared with data obtained after chemical group separation of the rare earths and with data reported by others; the agreement is, in general, good. La, Ce, Nd, Sm, Eu, and Gd were determined with the instrumental method and, after group separation, data were obtained for Th, Dy, Ho, Tm, Yb, Lu, and Sc in addition. It was concluded that the accuracy of the data obtained with the nondestructive method is, in general, as good as the precision for each element. (auth)

31300 SERVICE OXYGEN ANALYSES WITH 14-MeV NEUTRONS AT IOWA STATE UNIVERSITY. Clark, R. G.; Stensland, W. A. (Ames Lab., Iowa). J. Radioanal. Chem.; 4: 365-73(Mar 1970).

A 14-MeV neutron activation analysis system is described that is being used primarily to determine trace levels of oxygen in metals. No sample container is required for relatively inert solid metal samples thus increasing the sensitivity of the method by a factor of five. Under these conditions the sensitivity and precision for oxygen is about 6 ± 3.3 μg in a single determination, resulting from collecting 1.2 ^{16}N counts per μg of oxygen. A method is described for calibrating the system for the analyses of large metal samples. The preparation and use of sample containers for the analyses of particulate and/or reactive samples is also presented. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 31260, 31351, 31458, 31856, and 32488.

31301 (ANL-7489, pp 105-15) ISOTOPE EFFECTS IN THE PHOTOIONIZATION YIELDS AND ABSORPTION CROSS SECTIONS OF SEVERAL GASES. Person, James C.; Nicole, Paul P. (Argonne National Lab., Ill.).

Studies were made on isotope effects on the photoionization of acetone, ethylene, n-butane, acetylene, methylacetylene, and their perdeuterated analogs. Data are presented in tables and graphs. Data for acetone and methylacetylene indicated collision-induced ionization and isotope effects. No isotope effect was observed for acetylene. (M.C.G.)

31302 PROTON DYNAMICS IN KH_2PO_4 TYPE FERROELECTRICS STUDIED BY INFRARED ABSORPTION. Wiener, E.; Levin, S.; Pelah, I. (Soreq Nuclear Research Center, Yavne, Israel. Tel-Aviv Univ., Israel). J. Chem. Phys.; 52: 2881-91(15 Mar 1970).

The infrared absorption spectrum of ferroelectric crystals analogous to KH_2PO_4 was measured at several temperatures. Substantial changes in the intensity and width of the ir absorption peaks, especially in the low-energy spectral region, were observed upon crossing the Curie temperature. Assignments of the ir absorption peaks for both phases were made on the basis of a systematic comparison of the spectra of compounds isomorphic to KH_2PO_4 and containing isotopes of D and ^{18}O. Correlation charts were constructed for both phases, permitting harmonic interpretation of the ir selection rules. The structure of the ir absorption spectrum of KH_2PO_4 at temperatures above T_c, and comparison of this spectrum with that of KD_2PO_4, suggests a dynamic hydrogen symmetrizing process along the H bonds. It also indicates the existence of strong coupling between certain PO_4 modes and the soft longitudinal hydrogen modes, caused by the extremely anharmonic nature of the potential well along the H bond. The coupling results in a broadening of the PO_4 lines involved. The partial broadening that remains in KH_2PO_4 below T_c indicates that the soft hydrogen modes persist to a small extent even in the ferroelectric phase of this crystal. The ir data are explained on the basis of the fluctuating double-minimum-potential-well theory for the hydrogens. (auth)

31303 ANTIFERROELECTRIC TRANSITIONS IN $NH_4H_2PO_4$ AND $NH_4H_2AsO_4$ STUDIED BY INFRARED ABSORPTION. Wiener, E.; Levin, S.; Pelah, I. (Soreq Nuclear Research Center, Yavne, Israel. Tel-Aviv, Univ., Israel). J. Chem. Phys.; 52: 2891-2900(15 Mar 1970).

The antiferroelectric phase transition of $NH_4H_2PO_4$ and $NH_4H_2AsO_4$, as well as of their deuterated analogs, were studied by observing the changes in the infrared absorption spectra (250-4000 cm^{-1}) accompanying the phase transition. The behavior of the spectrum of $NH_4H_2PO_4$ and $ND_4D_2PO_4$ while approaching T_c suggests that the same hydrogen-dynamics mechanism is responsible for the phase transition in both cases, and that the fluctuating double-minimum-potential-well theory for the hydrogens applies here too. The differences observed at temperatures below T_c indicate a different final arrangement of the hydrogens in the antipolar phase. There are more PO_4 lines in the $NH_4H_2PO_4$ low-temperature spectrum, indicating that the hydrogens are arranged asymmetrically along the c axis, thus inducing an antiparallel dipole network. The ir absorption spectrum of a mixed crystal $NH_4H_2(AsO_4)_{0.95}(PO_4)_{0.05}$ was measured at different temperatures in order to check the validity of the site-group assignments in these crystals. The gradual reduction in the correlation field splitting on increasing the deuterium percentage in the antipolar phases of $ND_4D_2PO_4$ compounds suggests a more distorted deuteron network. Possible assignment for the absorption peaks in both phases of $NH_4H_2AsO_4$ and $ND_4D_2AsO_4$ (60% D) is given. (auth)

31304 PHASE VELOCITY AND ATTENUATION OF HYPERSOUND IN WATER OF DIFFERENT ISOTOPIC CONSTITUTION. Shaham-Bronstein, J.; Sarid, D.; Low, W. (Hebrew Univ., Jerusalem). J. Chem. Phys.; 52: 3201-3(15 Mar 1970).

Measurements of the phase velocity and the attenuation of sound in $H_2{}^{18}O$, $D_2{}^{16}O$, and $H_2{}^{18}O$ at 4.2 and 0.9 GHz, respectively, are reported. Spontaneous Brillouin scattering techniques and an injected phonon technique were employed. The phase velocities of $D_2{}^{16}O$ and $H_2{}^{18}O$ are very similar; classical theories cannot explain the experimental results. The values of α/f^2, the attenuation α divided by the frequency squared, are higher for $H_2{}^{18}O$ and D_2O than for $H_2{}^{16}O$. (auth)

31305 THEORETICAL STUDIES OF HOT-ATOM REACTIONS. II. YIELDS FOR EXCHANGE REACTIONS OF HOT TRITIUM ATOMS WITH HYDROGEN AND DEUTERIUM MOLECULES: SIMPLE MODELS FOR NONREACTIVE SCATTERING. Porter, R. N.; Kunt, Sinan (Univ. of Arkansas, Fayetteville). J. Chem. Phys.; 52: 3240-50(15 Mar 1970).

Results of calculations of hot-atom yields and isotope effects for T atoms in H_2 and D_2 are reported for a variety of compositions. Use is made of the integral reaction probability formalism, quasiclassical reaction cross sections, and three simplified models for nonreactive scattering, which preserve the energy independence of the average logarithmic energy loss. Theoretically predicted isotope effects are in good agreement with both high-energy T-recoil and low-energy photodissociation experiments for unmoderated systems. Anisotropic nonreactive scattering models give theoretical results generally in better agreement with experiment than does an isotropic model. The detailed energy and composition dependence of the hot-atom yield is examined and the errors incurred in the use of hot-atom kinetic theory are quantitatively analyzed. The kinetic-theory prediction that the high-moderator isotope effect is given by the ratio of the reactivity integrals and that the value is independent of the moderating mechanism is verified by results of the general theory for both ^4He- and Ar-moderated systems. Explanation of discrepancies between the theoretical and experimental isotope effects in the high-energy limit for Ar-moderated systems appears to require calculations which make fuller use of the general integral reaction probability formalism. (auth)

31306 COMMENT ON THE CALCULATION OF ISOTOPE-EXCHANGE EQUILIBRIUM CONSTANTS. EXCHANGE BETWEEN LITHIUM METAL AND LITHIUM BROMIDE SOLUTION. Stern, Marvin J.; Spindel, W. (Yeshiva Univ., New York). Contracts AT(30-1)-3462; AT(30-1)-3663. J. Chem. Phys.; 52: 3312-13(15 Mar 1970).

Exchange of ^6Li and ^7Li between lithium metal and lithium bromide solution was studied. Equations and calculated values are given. (M.C.G.)

31307 REPLY TO THE COMMENT ON THE CALCULATION OF LITHIUM ISOTOPE-EXCHANGE EQUILIBRIUM CONSTANTS. Hall, John C.; Rock, P. A. (Univ. of California, Davis). Contract AT(11-1)-34 PA 186. J. Chem. Phys.; 52: 3313-14(15 Mar 1970).

31308 REACTIONS OF URANIUM MONOCARBIDE AND URANIUM CARBONITRIDES WITH WATER VAPOR AND CARBON DIOXIDE. Benadik, A. (Nuclear Research Inst., Czechoslovak Academy of Sciences, Rez, Czech.); Blazek, A.; Ederova, J. Collect. Czech. Chem. Commun.; 35: 1154-69(Apr 1970).

Reactions of uranium monocarbide and carbonitrides with water vapor and carbon dioxide have been studied thermogravimetrically over a temperature range from 20 to 650°C under isothermal and nonisothermal conditions. Experimental results served for the determination of rate constants and activation energies of the reactions studied as well as for the explanation of the reaction mechanism of the oxidation of the examined compounds. (auth)

31309 ELECTRON SPIN RESONANCE STUDY OF DEAMINATION OF AMINO ACIDS BY HYDRATED ELECTRONS. Neta, P.; Fessenden, Richard W. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 74: 2263-6(28 May 1970).

ESR spectroscopy was used to observe the radicals produced by the reaction of hydrated electrons with amino acids in aqueous solutions. Irradiation with high energy electrons was carried out directly in the ESR cavity; the sample container was a flat cell of high-purity silica through which solutions were driven continuously. Either formate or methanol was used as an OH radical scavenger to eliminate reactions of OH with amino acids. In neutral solutions glycine, α-alanine, α-aminoisobutyric acid, iminodiacetic acid, nitrilotriacetic acid, betaine, glycylglycine, and benzylamine were found to undergo deamination, i.e., elimination of the NR_3^+ group, and the corresponding residual radicals were observed. Deamination was found to take place to a smaller extent in alkaline solutions, where the amino group is deprotonated. No deamination could be detected with β-alanine, acetylglycine, acetylalanine, acetamide, and allylamine. (auth)

31310 SOLVATION ENTHALPIES OF VARIOUS IONS IN WATER AND HEAVY WATER. Krishnan, C. V.; Friedman, H. L. (State Univ. of New York, Stony Brook). J. Phys. Chem.; 74: 2356-62(28 May 1970).

New data are reported for enthalpies of transfer of many electrolytes to D_2O from H_2O at 25°. Single ion enthalpies of transfer, based on the convention that the enthalpy of transfer is the same

for Ph_4As^+ and Ph_4B^-, are derived from these data together with some from the literature. For the tetraalkylammonium ions and the alkali ions the ionic enthalpies of transfer correlate very well with the Walden product ratios reported by Kay and Evans. For these ions and for several oxyanions the enthalpy of transfer seems to be about 5% of the total "structural" contribution to the enthalpy of solvation of the ion, while for the halide ions the enthalpy of transfer seems to be more than 10% of the structural enthalpy. The combination of these data for Li^+, Na^+, and K^+ with data obtained by Feder and Taube for the effect of these ions on the relative fugacities of $H_2{}^{16}O$ and $H_2{}^{18}O$ in water supports the interpretation of all of these effects in terms of a model in which one feature is a "structure-broken" region around Li^+ as well as around the other alkali ions. (auth)

31311 RADICAL INTERMEDIATES IN THE VACUUM ULTRAVIOLET PHOTOLYSIS OF CYCLOHEXANE AND CYCLOHEXENE VAPORS. Sevilla, M. D. (Atomic International, Canoga Park, Calif.); Holroyd, R. A. J. Phys. Chem.; 74: 2459-64(11 Jun 1970).

The radical intermediates in the vacuum uv photolysis of cyclohexane and cyclohexene vapor were identified. Two methods were used for radical detection: the $^{14}CH_3$-radical sampling method and ESR identification of the radicals trapped on a cold finger at 77°K. Results of the radical sampling technique show that at 1470 Å the principal radical intermediates in cyclohexane at 10 torr are methyl, allyl, and cyclohexyl. Similar results were obtained for cyclohexane-d_{12}. Increasing the photon energy results in an increase in the yields of methyl, allyl, and other fragment radicals. Although the spectrum of the allyl radical predominates, the ESR data are shown to be consistent with the radical sampling data. In cyclohexene the main radical intermediates at 1470 Å are methyl, allyl, cyclohexyl, and 3-cyclohexenyl. The mechanism of formation of radicals in these hydrocarbons is discussed. (auth)

31312 STABILITY CONSTANTS OF SOME METAL CHELATES OF TRIETHYLENETETRAMINEHEXAACETIC ACID (TTHA). Harju, Leo (Abo Akademi, Finland). Anal. Chim. Acta; 50: 475-89(Jun 1970).

Stability constants for Al(III), Cd(II), Co(II), Cu(II), Fe(III), Hg(II), La(III), Nd(III), Er(III), Mg(II), Mn(II), Ni(II), Pb(II), Th(IV), and Zn(II) complexes of triethylenetetraminehexaacetic acid (TTHA) have been evaluated from data obtained by pH and pM measurements. The pM method based on measurements with the mercury electrode and the redox system Fe(III)/Fe(II) proved to be very useful when binuclear complexes are formed. (auth)

31313 MECHANISM OF THE CATALYTIC HYDROGENATION OF α,β UNSATURATED CARBONYL COMPOUNDS. V. TRITIUM ISOTOPE EFFECTS. Simon, H.; Berngruber, O. (Technische Hochschule, Munich). Tetrahedron; 26: 1401-8(Mar 1970).

The isotope effects of the hydrogenation of some α,β-unsaturated carbonyl compounds with H_2/HT in the presence of different catalysts were determined. The isotope effects depend on both catalyst and substrate. In general the size decreases in the order Pt > Pd > Rh > tris(triphenylphosphine) rhodium chloride. For the hydrogenation of dimethyl acrylate the isotope effects shown by Pt, Pd, and Rh agree reasonably well with maximum calculated values assuming a reversible hydrogen addition to the β carbon and an irreversible addition to the α position. For the hydrogenation of fumarate another mechanism seems to be valid. (auth) (UK)

31314 ANALYSIS OF THE FINE STRUCTURE OF ABSORPTION SPECTRA OF URANYL NITRATE CRYSTALS AT 77°K. Kamyak, A. I.; Valadz'ko, L. V. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 115-20 (1969). (In Ukrainian).

Absorption spectra of $UO_2(NO_3)_2 \cdot 6H_2O$ and $RbUO_2(NO_3)_3$ crystals was studied at liquid nitrogen temperature. Four excited electronic states belonging to the uranyl ion were uncovered by means of the Levshin mirror symmetry rule and by assuming that the character of the linear polarized light is constant. The frequencies of pure electronic transitions were equal to 20,589, 21,488, 23,381, and 27,210 cm^{-1} for $UO_2(NO_3)_2 \cdot 6H_2O$ and 21,193, 21,790, 23,658, and 27,607 cm^{-1} for $RbUO_2(NO_3)_3$. The fine structure of the spectra was due to the intramolecular oscillations and oscillations of the crystalline lattice. The frequency of fully symmetric valence oscillations of the uranyl ion in excited states were equal to 726, 700, 712, and 714 cm^{-1} for $UO_2(NO_3)_2 \cdot 6H_2O$ and 775, 752, 750, and 740 cm^{-1} for $RbUO_2(NO_3)_3$. (R.V.J.)

31315 HYDROCHLORINATION OF CYCLOHEXENE IN ACETIC ACID. KINETIC AND PRODUCT STUDIES. Fahey, Robert C.; Monahan, Michael W.; McPherson, C. Allen (Univ. of California, San Diego, La Jolla). J. Amer. Chem. Soc.; 92: 2810-15(6 May 1970).

The reaction of cyclohexene with HCl in acetic acid yields cyclohexyl chloride (C) and cyclohexyl acetate (A) under conditions of kinetic control. The reaction rate and product composition were studied as a function of the concentration of cyclohexene, HCl, water, and tetramethylammonium chloride (TMAC). The effect of temperature as well as the deuterium isotope effect ($k_H/k_D = 1.3$) in DCl-DOAc were determined. The ratio of C to A was found (1) to be low (~3.0) at low [HCl] and in the absence of water or TMAC, (2) to increase significantly with the HCl concentration, with the water concentration, and with the TMAC concentration, and (3) to vary significantly with the temperature. These observations differentiate the reaction of cyclohexene from the reactions of styrene and t-butylethylene studied previously under similar conditions and indicate that the reaction of cyclohexene, unlike styrene and t-butylethylene, does not occur exclusively via a carbonium ion mechanism. Analysis of the rate and product data shows that there are two terms in the rate law, one involving acid and olefin and another involving acid, olefin, and dissociated chloride ion. The latter term corresponds to a termolecular mechanism leading to the formation of cyclohexyl chloride. The effect of water on the rate and product distribution is associated with its effect upon the ionization and dissociation of HCl. (auth)

31316 SYNTHESIS OF NEW THORIUM COMPOUNDS. Hulliger, Fritz (to American Cyanamid Co.). U. S. Patent 3,510,274. 5 May 1970. Filed 9 Apr 1968.

New thorium compounds of the formula ThXZ, in which X is selected from the group consisting of S, Sc and Te, and Z, P, As, Sb, and Bi, are prepared in microcrystalline form by sintering powders of the constituent elements at temperatures up to 650 to 900°C. The products are diamagnetic or weakly paramagnetic, show metallic conductivity, and have low thermoelectric powers. (auth)

31317 SOLUTION LUMINESCENCE OF METAL COMPLEXES. Lytle, Fred E. (Purdue Univ., Lafayette, Ind.). Appl. Spectrosc.; 24: 319-26(May-Jun 1970).

An overall view of the solution luminescence of metal complexes is given. The three major classes of emission are examined in moderate detail including brief discussions of theoretical considerations. These are attuned to the problem of predicting which metal ion–ligand combinations should form luminescent compounds. Finally, the elements are covered group by group and as many examples of emitting compounds are given as possible. (auth)

31318 CONTRIBUTION TO THE CHEMISTRY OF THE RARER ELEMENTS. LXI. CONTRIBUTION TO THE STUDY OF THE STRUCTURE OF SCANDIUM MONOXIDE. Petru, F.; Brozek, V.; Dufek, V. (Inst. of Chemical Tech., Prague). Collect. Czech. Chem. Commun.; 35: 1041-6(Apr 1970).

The preparation of sintered samples of scandium monoxide is described and their crystal structure studied. As certain Debye–Scherer diagrams of the samples displayed diffraction lines which could be assigned either to thorium dioxide or to hyperstructural reflections, an analysis of compact samples of scandium monoxide on microanalyzer JXA-3A was carried out. The presence of thorium dioxide inclusions in the starting scandium oxide was lower than 0.1%. In view of the high atomic number of thorium this amount is sufficient to show relatively intense lines on a guinierogram which can influence the structural analyses. (auth)

31319 DEHYDRATION OF ALCOHOLS ON ALUMINA. XII. KINETIC ISOTOPE EFFECTS IN THE OLEFIN FORMATION FROM BUTANOLS. Knoezinger, Helmut; Scheglila, Amin (Univ., Munich). J. Catal.; 17: 252-63(May 1970).

Primary kinetic isotope effects on the dehydration from the gas phase of tertiary, secondary, and iso-butanol on alumina were measured in a temperature range between 120 and 230°C. The deuteration of the hydroxyl group did not give rise to an isotope effect, whereas substitution of the β-proton by deuterium produced an appreciable effect. From the dependence of the isotope effects on substrate structure and temperature it could be concluded that at temperatures below 200°C primary, secondary, and tertiary alcohols are dehydrated via E2-like reaction intermediates over alumina, which presumably contain a certain degree of ionic contributions. With increasing temperature these ionic contributions are favored so that at higher temperatures, depending on the reactant structure, the reaction may proceed via a E1 mechanism. (auth)

31320 OXYGEN ISOTOPE EFFECTS IN SYNTHETIC REVERSIBLE OXYGEN CARRIER SYSTEMS: COBALT DIHISTIDINE–OXYGEN SYSTEM. Jeevanandam, M.; Gupta, A. R. (Bhabha Atomic Research Center, Trombay, India). J. Inorg. Nucl. Chem.; 32: 1749-50(May 1970).

Many inorganic complexes absorb O_2 gas reversibly with the formation of molecular oxygen complexes. The properties of the oxygenated cobalt dihistidine complex were studied in detail. In the equilibrium between molecular oxygen and the cobalt dihistidine complex a fractionation of oxygen isotopes was expected, the magnitude depending on the strength of the bonds formed between molecular oxygen and the complex. A study of the oxygen isotope effects in an aqueous medium at 0°C and 24°C is described. It was found that ^{18}O tends to prefer the gas phase. The enthalpy change for the system was consistent with the generally low values of such changes for isotopic exchange reactions. It is considered that, if a suitable reflux mechanism were devised, this system might be useful for the chemical separation of oxygen isotopes, since the single stage separation factor is the highest known, except for the CO_2/H_2O exchange system. (UK)

31321 STRUCTURAL MODEL OF THE HYDRATED ELECTRON. Natori, Makoto; Watanabe, Tsutomu (Tokyo Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 264-6(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A proposed structure is given for the hydrated electron. Agreement with experimental data was found to be satisfactory. It is proposed that the shape of the water molecule is different between crystalline ice and liquid water. As the cavity size increases, the excitation energy decreases. This tendency is in accord with the temperature and pressure effects of the optical absorption spectrum. The oscillator strength is rather large. This is due to the approximation used in the calculation. The agreement of the calculated physical properties with experimental data showed that the proposed model is a reasonable one. (P.C.H.)

31322 PHYSICAL PROPERTIES OF POLYOXYMETHYLENE PREPARED BY POSTPOLYMERIZATION OF TRIOXANE. Ito, Akihiko (Japan Atomic Energy Research Inst., Tokyo); Iwai, Tadashi; Aramaki, Teruo; (and others). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 301-3(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

An evaluation was made of the physical properties of acetylated polyoxymethylene prepared by the use of a pilot scale reactor, which was designed for the post-irradiation polymerization of trioxane in the solid state. Delrin, the acetylated polyoxymethylene manufactured from anhydrous formaldehyde by catalytic polymerization, was used as a reference. The results showed that there was essentially no difference in mechanical properties and very little difference was observed in melt-flow behavior. (P.C.H.)

31323 PREPARATION OF WOOD-POLYVINYLIDENE CHLORIDE COMPOSITE BY RADIATION. Gotoda, Masao (Japan Atomic Energy Research Inst., Tokyo); Tsuji, Tadasi; Toyonish, Sigekazu; Hagifuji, Yasuhiko; Tsubomoto, Kazuo. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 304-6(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the γ-radioinduced polymerization of vinylidene chloride impregnated in wood for the purpose of improving inflammability and dimensional stability of the wood. The results showed that the extent of impregnation and polymerization of vinylidene chloride in woods and also their dispersion depended on the kind of wood. Among the woods tested, beech was the best. Also, γ radiation was found to be preferable over electron irradiation. However, with γ radiation, bulking effect appeared only slightly in the later stage of polymerization for wood with low moisture content, but appeared from the beginning for wood with large moisture content. In the case of electron irradiation, a large bulking effect appeared for the latter, whereas the volume contraction of the wood was observed for the former. (P.C.H.)

31324 NEW METHODS FOR IODINE LABELLING OF ORGANIC COMPOUNDS. Elias, H. (Technische Hochschule, Darmstadt, Ger.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 538-46 (1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

New methods are suggested for the preparation of ^{131}I- and ^{125}I-labeled compounds and are discussed on the basis of results obtained for a large variety of organic iodides. The methods are: labeling by isotopic exchange in gas chromatographic columns; labeling by radioinduced isotopic exchange; and labeling by isotopic exchange in melts. The last method offers several advantages over the first method. However, it is restricted to volatilizable aliphatic iodides. The last two methods are widely applicable and of special interest for those aromatic iodides that cannot be labeled by isotopic exchange in solution. (P.C.H.)

31325 IONIC RADON SOLUTIONS. Stein, Lawrence (Argonne National Lab., Ill.). Science, 168: 362-4(17 Apr 1970).

Radon is oxidized between −195° and 25°C by chlorine fluorides, bromine fluorides, iodine heptafluoride, and NiF_6^{2-} ion in hydrogen fluoride with the formation of stable solutions of radon fluoride. Electromigration studies show that the radon is present as a cation, possibly Rn^{2+} or RnF^+, in several conducting solutions. (auth)

31326 STUDIES OF Th(IV) COMPLEX FORMATION WITH ACETIC ACID BY MEANS OF pH-POTENTIOMETRIC METHOD. Sergeev, G. M.; Astrashkova, L. G.; Yagodinskaya, N. N. Radiokhimiya; 12: 392-3(1970). (In Russian).

The complexing of Th(IV) with acetate ions was studied by pH-potentiometric titration. The dissociation constant of acetic acid measured at $\mu = 0.5$ and 25°C was equal to $(3.04 \pm 0.03) \times 10^{-5}$ at an order of accuracy of 95%. Hydrolysis of Th ions treated at values of $n \leq 1.5$ and $pH \leq 3$ was inhibited. The complexing reactions were expressed as: $Th^{4+} + HAc \rightleftharpoons ThAc^{3+} + H^+$ and $ThAc^{3+} + HAc \rightleftharpoons ThAc_2^{2+} + H^+$. It was found that thorium acetate complexes are less stable in solutions than other known thorium complexes with organic additions, but they have a higher stability than simple inorganic chloride, nitrate, and sulfate complexes. (R.V.J.)

31327 STUDY OF THE MECHANISM OF SORPTION OF METAL IONS ON CARBOXYLIC CATION EXCHANGERS. V. THE FORMATION OF COMPLEX URANYL COMPOUNDS OF THE TYPE $[Me(A)_3]^-$. Chuveleva, E. A.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Izv. Fiz. Khim.; 44: 482-5(Feb 1970). (In Russian).

A study was made of the conditions of formation of uranyl complexes with three carboxylic groups of the SG-1 resin. The probability of formation of complex compounds with the coordination of the maximum number of active groups of the resin increased with decreasing concentration of the metal in the initial solution. (tr-auth)

31328 CYCLIC CHRONOPOTENTIOMETRY. DETERMINATION OF TYPES AND RATES OF SECOND ORDER CHEMICAL REACTIONS FOLLOWING ELECTRON TRANSFER. Vukovic, M.; Pravdic, V. (Ruder Boskovic Inst., Zagreb). Croat. Chem. Acta; 42: 21-32(1970).

Cyclic chronopotentiometry, a technique used for studying coupled chemical and electrochemical reaction mechanisms, was extended to include determination of types and rates of second order chemical reactions following electron transfer. The math. treatment was derived on the basis of Feldberg's method of digital simulation. Diagnostic curves are given for kinetic and disproportionation reactions. The disproportionation reaction of U(V) in carbonate solution was used for an experimental test. The rate coefficient of a second order disproportionation reaction was determined to within ±2% of a typical value of 10.1 $mole^{-1}$ sec^{-1}. The technique is applicable for second order rate coefficients between 10^{-1} and 10^5 1 $mole^{-1}$ sec^{-1}. (auth)

31329 FORMATION OF 1,8-NAPHTHALIDE, 3,3-DIMETHYLPHTHALIDE, AND 3,3-DIPHENYLPHTHALIDE IN AQUEOUS SOLUTION. GENERAL ACID CATALYSIS OF ESTERIFICATION. Weeks, Daniel P.; Creary, Xavier (Seton Hall Univ., South Orange, N. J.). J. Amer. Chem. Soc.; 92: 3418-21(3 Jun 1970).

In aqueous acid 8-hydroxymethyl-1-naphthoic acid cyclizes to the lactone, 1,8-naphthalide. The reaction is subject to catalysis by the acidic components of buffers of various structural types. In acetic acid buffer the catalytic rate constant, k_{HOAc}, is 3.35×10^{-2} $\underline{M}^{-1}$ sec^{-1}, the solvent kinetic isotope effect, k_{HOAc}/k_{DOAc}, is 2.29, and the entropy of activation for the acetic acid catalysis is −38 eu. The formation of 3,3-dimethylphthalide and, on the basis of more limited data, the formation of 3,3-diphenylphthalide from their corresponding hydroxy acids behave similarly. These data are consistent with a rate-determining step involving proton transfer. (auth)

31330 DEUTERIUM ISOTOPE EFFECTS ON THE FLUORESCENCE OF TRYPTOPHAN IN PEPTIDES AND IN LYSOZYME. Lehrer, Sherwin S. (Harvard Medical School, Boston). J. Amer. Chem. Soc.; 92: 3455-62(3 Jun 1970).

A study was made of the variation of fluorescence with pH and pD for the tryptophan model compounds, skatole, L-trp, L-trp-L-tyr, and N-Cbz-L-trp-L-tyr, and for the tryptophyl fluorescence of lysozyme and of the lysozyme-triNAG complex. Shifts of the fluorescence transitions by 0.3 to 0.7 pH unit in D_2O compared to H_2O gave further evidence for the involvement of amino, carboxyl, and phenol groups in the quenching of tryptophyl fluorescence. The large isotope effects observed are consistent with the expected decreased rate of deuteron transfer when the protons of the amino and carboxyl groups are exchanged for deuterons in D_2O. The

value for the ratio of the rate constant for the intramolecular quenching by the NH_3^+ group of L-trp in H_2O and D_2O was calculated to be 2.7 from the experimental data and a simple kinetic scheme. A large isotope effect was also observed for the intermolecular quenching of indole-3-acetamide by glycine at neutral pH. These data are consistent with a proton transfer quenching mechanism. The results of the study with lysozyme provide further evidence for the involvement of acid groups in the quenching of tryptophan fluorescence. (auth)

31331 α-DEUTERIUM ISOTOPE EFFECTS ON THE SOLVOLYSES OF NORBORNYL BROSYLATES AND SYNTHESIS OF LABELED NORBORNYL DERIVATIVES. Murr, B. L.; Conkling, J. A. (Johns Hopkins Univ., Baltimore). J. Amer. Chem. Soc.; 92: 3462-4(3 Jun 1970).

Evidence is presented that excludes scrambling as the cause of the low α-isotope effect along with evidence that isotopic scrambling can accompany conversion of deuterated indo-norbornyl brosylates to exo-norbornyl acetates with tetramethylammonium acetate in acetone. The α-isotope effect on aqueous ethanolysis was the same as for acetolysis. (M.C.G.)

31332 DYNAMIC STEROCHEMISTRY: A COMPARATOR FOR ELECTRON IMPACT AND PYROLYTIC ELIMINATION OF ACETIC ACID FROM ACETATES. Green, Mark M.; Moldowan, J. Michael; Hart, David J.; Krakower, Jeffrey M. (Univ. of Michigan, Ann Arbor). J. Amer. Chem. Soc.; 92: 3491-2 (3 Jun 1970).

The diastersomeric 3-deuterio sec-butyl acetates (1 and 2) and 2-deuterio-1, 2-diphenyl ethyl acetates (3 and 4) were prepared. Data revealed a stereochemical dependence as well as a greater average loss of deuterated acetic acid from 3 and 4 over 1 and 2. The isotope effect was calculated. (M.C.G.)

31333 METAL ISOTOPE EFFECT ON METAL–LIGAND VIBRATIONS. I. PHOSPHINE COMPLEXES. Shobatake, Kosuke; Nakamoto, Kazuo (Marquette Univ., Milwaukee). J. Amer. Chem. Soc.; 92: 3332-5(3 Jun 1970).

Far-infrared spectra (600-100 cm^{-1}) are reported for $^{58}Ni(PEt_3)_2Cl_2$, $^{58}Ni(PEt_3)_2Br_2$, $^{58}Ni(PPh_3)_2Cl_2$, $^{104}Pd(PEt_3)_2Cl_2$, $^{104}Pd(PPh_3)_2Cl_2$, and their ^{62}Ni or ^{110}Pd analogs. The infrared and Raman spectra of $Pd(PPh_3)_2X_2$ and $Pd(AsPh_3)_2X_2$ (X = Cl and Br) were also obtained. Based on observed isotopic shifts, the Ni–P stretching vibrations were assigned at Ca. 274-260 cm^{-1} (one band) for trans-$Ni(PEt_3)_2X_2$ and at ca. 190-160 cm^{-1} (two bands) for tetrahedral $Ni(PPh_3)_2X_2$. Similarly, the Pd-P stretching bands were assigned at ca. 235-232 cm^{-1} for trans-$Pd(PEt_3)_2X_2$ and at ca. 190 cm^{-1} for trans-$Pd(PPh_3)_2Cl_2$. (auth)

31334 METAL ISOTOPE EFFECT ON METAL–LIGAND VIBRATIONS. III. π-ALLYL COMPLEXES OF PALLADIUM(II). Shobatake, Kouske; Nakamoto, Kazuo (Marquette Univ., Milwaukee). J. Amer. Chem. Soc.; 92: 3339-42(3 Jun 1970).

The infrared and Raman spectra of four Pd(II) π-allyl complexes were measured from 4000 to 100 cm^{-1}. The far-infrared spectra of $[^{104}Pd(\pi\text{-}C_3H_5)Cl]_2$ and its ^{110}Pd analog were obtained. From the observed isotopic shifts, the Pd-allyl stretching bands were assigned at ca. 400 and 370 cm^{-1}. The Pd–Cl (bridging) and Pd–Br (bridging) stretching bands are located at ca. 260-240 and 190-170 cm^{-1}, respectively. (auth)

31335 METAL ISOTOPE EFFECT ON METAL–LIGAND VIBRATIONS. II. TRIS COMPLEXES OF 2,2'-BIPYRIDINE AND 1,10-PHENANTHROLINE. Hutchinson, B.; Takemoto, J.; Nakamoto, K. (Illinois Inst. of Tech., Chicago, Marquette Univ., Milwaukee). J. Amer. Chem. Soc.; 92: 3335-9(3 Jun 1970).

The far-infrared spectra (500-150 cm^{-1}) of isotopic pairs were obtained for the $[Fe(bipy)_3]^{2+}$ (^{54}Fe and ^{57}Fe), $[Ni(bipy)_3]^{2+}$ and $[Ni(phen)_3]^{2+}$ (^{58}Ni and ^{62}Ni), and $[Zn(bipy)_3]^{2+}$ and $[Zn(phen)_3]^{2+}$ (^{64}Zn and ^{68}Zn) ions. Based on the observed isotopic shifts, the Fe–N, Ni–N, and Zn–N stretching bands were assigned at 375-360, 300-240, and 240-175 cm^{-1}, respectively. (auth)

31336 β-DEUTERIUM ISOTOPE EFFECTS ON THE SOLVOLYSES OF NORBORNYL BROSYLATES. Murr, B. L.; Conkling, J. A. (Johns Hopkins Univ., Baltimore). J. Amer. Chem. Soc.; 92: 3464-6(3 Jun 1970).

Identification of a heretofore unrecognized cause for the low C_3 isotope effect on solvolysis of exo-norbornyl derivatives is reported. Results were consistent with the hypothesis that the β-isotope effect results solely from relief of steric strain. (M.C.G.)

31337 ELECTRON SPIN RESONANCE SPECTRA OF RADICALS PRODUCED BY HYDROGEN AND DEUTERIUM BOMBARDMENT OF UNSATURATED ORGANIC COMPOUNDS AT 77°K. Morgan, Cornelius U.; White, Kevin J. (Army Ballistic Research Labs., Aberdeen Proving Ground, Md.). J. Amer. Chem. Soc.; 92: 3309-12(3 Jun 1970).

The radicals produced by interaction of unsaturated hydrocarbons with hydrogen atoms at 77°K was studied by electron spin resonance (ESR). The hydrogen atom adds directly to the double bond of ethylene, 1,3-butadiene, and benzene to produce the ethyl, 2-butenyl, and cyclohexadienyl radicals, respectively. In the case of the interaction of hydrogen atoms with 1-butyne and 1,2-butadiene, the methylallenyl radical was observed in each case. On bombardment of 1,4-cyclohexadiene and propyne with hydrogen atoms the cyclohexadienyl and allenyl radicals were observed. These last four reactions can be explained by assuming an addition reaction of hydrogen with the compound. The radical produced immediately abstracts a hydrogen atom from the parent compound to yield the observed stable radical. For the 1,2-butadiene–hydrogen interaction, such a mechanism accounts for the ESR spectrum and for the 2-butyne and 2-butene observed by Klein and Scheer in their analysis of the products of this reaction after warming to room temperature. The formation of 2-butene and 2-butyne can also be explained, respectively, by a double addition and an addition and abstraction reaction of hydrogen with 1,2-butadiene. In this case the radical observed by ESR would be explained by a single abstraction reaction. (auth)

31338 VAPORIZATION AND THERMODYNAMICS OF THE PRASEODYMIUM AND GADOLINIUM SULFIDES Pr_3S_4 AND GdS AND THE DISSOCIATION ENERGY OF PrO. Fries, James Andrew. Iowa City, Iowa; Univ. of Iowa (1969). 180p. Thesis.

Pr_3S_4 and GdS were synthesized by reaction of the elements at 450°C, followed by annealing at high temperatures in vacuum. Lattice parameters of the oxide-free samples are 8.5664 ± 0.0003 Å and 5.5620 ± 0.0004 Å, respectively. The vaporization of Pr_3S_4 and of GdS from Knudsen cells made of tungsten was then followed by means of a time-of-flight mass spectrometer at nominal ionizing electron energies of 12 eV. Pr_3S_4 was found to vaporize congruently over the temperature range studied, 1950 to 2104°K. Only Pr^+, PrS^+, and S^+, corresponding to vapor species of the same formulas, were observed in the mass spectrum of the vapor. Partial pressures for Pr and PrS were calculated by assuming a sensitivity constant ratio X_{PrS}/X_{Pr} of 1.10 and by combining the mass spectrometric data with the results of an earlier vacuum balance study by Holler. The partial pressure of sulfur was then calculated from stoichiometric requirements. Enthalpies and entropies of reaction for the atomization of Pr_3S_4 and the dissociation of $PrS_{(g)}$ were then calculated by both second- and third-law procedures. The dissociation energy of $PrS_{(g)}$ was also obtained from an isomolecular sulfide exchange reaction, $Y_{(g)} + PrS_{(g)} = YS_{(g)} + Pr_{(g)}$, in the vapor in equilibrium with a solid PrS–YS mixture, using the dissociation energy of $YS_{(g)}$, 125.7 ± 3.0 kcal/mole, as a standard. Second-law values for $D_0^\circ(PrS_{(g)})$ from these two studies are in excellent agreement, and in view of the large uncertainties in calculated third-law values, the second-law results for the following reactions at 2100°K are reported as "best" values. $PR_3S_{4(s)} = 3\ Pr_{(g)} + 4\ S_{(g)}$ $\Delta H_{2100}^\circ = 906.0 \pm 11.6$ kcal/mole, $PrS_{(g)} = Pr_{(g)} + S_{(g)}$ $\Delta H_{2100}^\circ = 125.9 \pm 4.0$ kcal/mole, $D_0^\circ(PrS_{(g)}) = 120.0 \pm 4.0$ kcal/mole. The heat of formation of solid Pr_3S_4 at 298°K was calculated using literature values for the heats of sublimation of Pr and S, and the heat of atomization of Pr_3S_4 obtained in this study. A value for $\Delta H_{f(298°K)}^\circ$ $(Pr_3S_{4(g)}) = -130.7 \pm 4.0$ kcal/gm-atom metal, was obtained. This may be compared with the calorimetric value for Ce_3S_4, -131.6 ± 1.0 kcal/gm-atom metal. GdS was shown to vaporize congruently over a temperature range 2010 to 2290°K. The ions Gd^+, GdS^+, and S^+ were observed in the mass spectrum. Partial pressures of the primary neutral species Gd, GdS, and S could not be calculated due to the lack of total vapor pressure data. Second-law values for the heats of sublimation of GdS at 2150°K to gaseous molecules, 138.8 ± 4.0 kcal/mole, and to the gaseous atoms, 275.5 ± 4.0 kcal/mole, as well as for the dissociation energy of $GdS_{(g)}$ were obtained. The dissociation energy of $GdS_{(g)}$ was also determined by means of the following gaseous isomolecular exchange reaction in the vapor in equilibrium with a GdS–YS solid solution, $Y_{(g)} + GdS_{(g)} = YS_{(g)} + Gd_{(g)}$. The dissociation energy of $YS_{(g)}$, 125.7 + 3.0 kcal/mole, was taken as a standard. Smoes et al. reported a value of 124.5 ± 3.5 kcal/mole for the dissociation energy of $GdS_{(g)}$ obtained from isomolecular sulfide exchange reactions using $YS_{(g)}$ and $CeS_{(g)}$ as standards. All values for the dissociation energy of $GdS_{(g)}$ from the present study are in agreement with the value of Smoe et al., which is therefore reported as the "best" value. The heat of formation of solid GdS at 0°K, -112.7 ± 6.0 kcal/mole, was calculated using literature values for the heats of sublimation of solid Gd and S and the heats obtained in this study. The dissociation energy of $PrO_{(g)}$, 179.5 ± 4.0 kcal/mole was obtained from an isomolecular oxide exchange reaction, $Y_{(g)} + PrO_{(g)} = YO_{(g)} + Pr_{(g)}$, using the dissociation energy of $YO_{(g)}$, 168.6 ± 2.3 kcal/mole, from Ackermann and Rauh as a standard.

Good agreement with the results of Ames et al. is reported. (Diss. Abstr. Int., B)

31339 PERIODICITY AND THE LANTHANIDES AND ACTINIDES. Moeller, Therald (Arizona State Univ., Tempe). J. Chem. Educ.; 47: 417-23(Jun 1970).

Periodicity in relationship to the other elements, periodicity between the lanthanide and actinide series, and periodicity within each series are discussed. (M.C.G.)

31340 EFFECT OF THIRD COMPONENT ADDITIONS ON THE REACTION RATE OF CH_3I WITH $Na_2S_2O_3$. Soldano, B. A. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 207(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Radiation and Nuclear Chemistry

Refer also to abstracts 31305, 31321, 31363, 31447, 31449, 31453, 31856, 32336, and 32911.

31341 (DP-1146) CURIUM PROCESS DEVELOPMENT. IV. EQUIPMENT DEVELOPMENT AND TESTING. Kishbaugh, Albert A.; Bull III, Harcourt; Gibson, George W. Jr.; Landon, Lewis F. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Sep 1969. Contract AT(07-2)-1. 70p. Dep. CFSTI.

The major equipment required for separating curium, americium, and californium and for preparing purified curium and americium oxides in the Curium Processing Facility of the Savannah River Laboratory was tested under simulated process conditions prior to installation into three shielded cells. Modifications to the equipment were made where necessary for proper performance; operating procedures were developed to ensure satisfactory process control. (auth)

31342 (NYO-3383-17) STUDIES ON PRIMARY PROCESSES IN THE RADIATION CHEMISTRY OF LIQUIDS AND ON THE MECHANISM OF THE INTERACTION OF RADIATION ON BIOLOGICALLY IMPORTANT CHEMICAL SYSTEMS. Progress Report, June 1, 1969-June 8, 1970. Trumbore, Conrad N. (Delaware Univ., Newark. Dept. of Chemistry). Contract AT(30-1)-3383. 14p. Dep. CFSTI.

The importance, as well as the complexity, of the p-nitrosodimethylaniline (RNO) system as a primary standard for measuring OH radical rate constants is discussed. Quantitative studies are reported on the similarities between flash photolysis and pulse radiolysis of the aqueous RNO system. The suggestion is made that photolysis of water is responsible for the observed phenomena. Increasing evidence is reported for the role of water structure in aqueous radiation chemistry and radiation biology as well as in unirradiated biological systems. Preliminary results of the effects of added "structure-making" and "structure-breaking" salts on pulse radiolysis results, as well as on the formation and radiation chemistry of micelles, are reported. The remarkable resistance, higher than any other reported living system, of certain of the blue-green algae is reported. It is noted that viral attack on these algae weakens the radiation resistance of certain algae. (auth)

31343 (NYO-3383-18) STUDIES ON PRIMARY PROCESSES IN THE RADIATION CHEMISTRY OF LIQUIDS AND ON THE MECHANISM OF INTERACTION OF RADIATION WITH BIOLOGICALLY IMPORTANT CHEMICAL SYSTEMS. Progress Report, March 22, 1967-June 8, 1970. Trumbore, C. N. (Delaware Univ., Newark. Dept. of Chemistry). 8 Jun 1970. Contract AT(30-1)-3383. 7p. Dep. CFSTI.

Research progress is summarized on: energy transfer in organic liquids, low solute concentration effects in aqueous radiation chemistry, fast electron decays in pulse radiolysis, a standard for OH radical rate constants, mechanism of radiolysis of aqueous cysteine solutions, and radiation resistance of blue-green algae. (M.C.G.)

31344 EFFECT OF HIGH-ENERGY RADIATION ON THE ELECTRICAL CHARACTERISTICS OF PYRRONE POLYMERS. Reucroft, P. J.; Scott, H.; Kronick, P. L.; Serafin, F. L. (Franklin Inst. Research Labs., Philadelphia). Contract NASI-7408. J. Appl. Polym. Sci.; 14: 1361-72(May 1970).

Gamma radioinduced conductivity and permanent conductivity effects produced by high doses of 2-MeV electrons have been measured in two polyimidazopyrrolone polymers. Radioinduced conductivity levels were small compared to those found in many common insulating polymers. Permanent increases in dark conductivity produced by accumulated doses of 5×10^9 Rad at temperatures up to 300°C were not sufficient to inhibit ultraviolet-visible photoconductivity. High doses of 2-MeV electrons (5×10^9 Rad) under the same temperature conditions produced no discernible effect on dielectric properties. Both radioinduced conductivity and permanent dark conductivity increases were much smaller in one polymer (BTDA-DAB), suggesting the possibility of optimizing radiation resistance in this class of polymers by means of chemical structure variation. The radiolytic and thermal stability reported previously for this class of polymers has been generally confirmed, with particular reference to electrical properties. (auth)

31345 SEPARATION OF CARRIER-FREE ^{48}V FROM DEUTERON-BOMBARDED TITANIUM BY SOLVENT EXTRACTION. Ohno, S. (National Inst. of Radiological Sciences, Chiba, Japan); Inarida, M.; Shimamura, A. Radiochem. Radioanal. Lett.; 4: 29-33(10 May 1970).

A solvent extraction method for the separation of carrier-free ^{48}V in deuteron-bombarded titanium metal powder is described. Carrier-free ^{48}V was extracted with a quinaldic acid-pyridine-chloroform system. (auth)

31346 EFFECT OF HYDROGEN SULPHIDE ON THE YIELDS OF SOME IONIC PRODUCTS IN GASEOUS ETHYLENE RADIOLYSIS. Niedzielski, J.; Gawlowski, J. (Univ. of Warsaw). Radiochem. Radioanal. Lett.; 4: 21-7(10 May 1970).

Gamma radiolysis of gaseous ethylene has been investigated in the presence of varying concentrations H_2S. The marked enhancement of 1-butene, trans and cis 2-butene yields has been observed [$G(\Sigma\ C_4H_8) = 1.7$]. This increase cannot be explained by free radical reactions. It has been concluded that complex $C_4H_9H_2S^+$ ions, unreactive towards ethylene, yield butenes after neutralization. The high yield of methane [$G(CH_4) = 1.5$] is also due to the disturbing influence of H_2S on ion-molecule reactions in ethylene. (auth)

31347 PRODUCTION OF ^{81}Rb AND ^{82m}Rb FOR MEDICAL USE. Watson, I. A. (Sloan-Kettering Inst. for Cancer Research, New York). Radiochem. Radioanal. Lett.; 4: 7-14(10 May 1970).

A method for the preparation of a solution of ^{81}Rb and ^{82m}Rb activities suitable for intravenous injection is described. Yields of these two isotopes have been measured in sodium bromide targets bombarded with ^3He particle beams of 15 to 22 MeV. The results of these measurements are reported and compared with yields from bombardments with ^4He particle beams of similar energy. (auth)

31348 RADIOLYSIS OF LIQUID BENZENE-TETRACHLOROMETHANE MIXTURES BY ^{60}Co γ RAYS. IV. DECOMPOSITION WITH HIGH BENZENE CONCENTRATIONS. Schweiner, Z.; Bednar, J. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett.; 3: 389-95(7 May 1970).

Even with high benzene concentrations the main processes leading to measured products are neutralization of positive ions $C_6H_6^+$ by negative Cl^- ions and reaction of triplet molecules $C_6H_6^T$ with tetrachloromethane. The material balance of radiolysis gradually breaks down owing to increasing formation of benzene "polymer." (auth)

31349 RADIOLYSIS OF LIQUID BENZENE-TETRACHLOROMETHANE MIXTURES BY ^{60}Co γ RAYS. III. IONIC MECHANISM AT MODERATE BENZENE CONCENTRATIONS. Schweiner, Z.; Bednar, J. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett.; 3: 383-7(7 May 1970).

Neutralization of $C_6H_6^+$ ions by Cl^- ions and reactions of triplet benzene molecules with tetrachloromethane are the most important decomposition processes in the gamma radiolysis of mixtures containing 20 to 60 moles of benzene. (auth)

31350 CHEMICAL BEHAVIOR OF THE RECOIL ^{57}Co FORMED BY THE DECAY OF ^{57}Ni-LABELLED HEXAMMINENICKEL(II) COMPLEXES. Omori, T.; Wu, Shaw-chii; Shiokawa, T. (Tohoku Univ., Sendai). Radiochem. Radioanal. Lett.; 3: 405-9(7 May 1970).

As a result of electron capture and β^+ decay of ^{57}Ni-labeled hexammineniekel(II) complex, a fairly large amount of ^{57}Co(III) species is produced, depending on the nature of the outer-sphere anion. This tendency is generally emphasized on thermal anhealing. It is suggested that the fate of ^{57}Co produced in a matrix of nickel(II) complex is predominantly determined by the chemical property of the daughter complex. (auth)

31351 PERIODIC SYSTEM OF D. I. MENDELEEV AND PROBLEMS OF NUCLEAR CHEMISTRY. Gol'danskii, V. L. (Inst. for Chemical Physics, Moscow). J. Chem. Educ.; 47: 406-16; 30(Jun 1970).

The direct ties between the periodic system of the elements and problems of nuclear chemistry are discussed. The acquisition and identification of new chemical elements and structure of the eighth period of D. I. Mendeleev's system are considered. Problems of the chemistry of new atoms are reviewed. (M.C.G.)

31352 PULSE RADIOLYSIS OF NUCLEIC ACID CONSTITUENTS AND RELATED COMPOUNDS. III. OPTICAL SPECTRA AND REACTIVITY OF ORGANIC FREE RADICALS FORMED BY REACTION OF HYDROXYL FREE RADICALS WITH PYRIMIDINE BASES. Myers, L. S. Jr.; Hollis, Mary Lynn; Theard, L. M.; Peterson, F. C.; Warnick, Aida (Univ. of California, Los Angeles. Gulf General Atomic Inc., San Diego, Calif.). J. Amer. Chem. Soc.; 92: 2875-82(6 May 1970).

Dilute N_2O-saturated aqueous solutions of uracil (U), thymine (T), cytosine (C), and 5-methylcytosine (MC) were irradiated with submicrosecond pulses of 10-MeV electrons, and changes in optical absorbance in the wavelength range 300 to 600 nm were monitored for periods up to 1700 μsec. Radicals formed at pH 7 by reaction of OH· with pyrimidine bases have spectra with the following maxima: U, 375, T, 375, C, 335, 440, MC, 325, 485 nm. These spectra decay for 50 to 80 μsec without significant change in shape. Spectra of radicals formed at pH 11.4 and ~12.5 differ from pH 7 spectra. Compounds with a 5-methyl group give spectra at pH ~12.5 with a pronounced absorption maximum near 525 to 550 nm, which is absent from spectra of 5-hydro compounds. At the higher pH's spectra undergo changes in shape at rates that are much faster than radical decay. These reactions are pseudo-first-order and their rates depend on pH. They are attributed to reactions between radicals and OH^- ion. Four general kinds of organic free radicals are found: R_1· (neutral radicals formed by addition of OH· to a base in neutral solutions); R_2· (singly charged anionic radicals obtained by addition of OH· to pyrimidine base anions in alkaline solutions or by reaction of R_1· with OH^-); R_3· (doubly charged anionic radicals obtained by addition of O^- to pyrimidine base anions in strongly alkaline solutions, or reaction of R_2· with OH^-); and R_4· (substituted methyl radicals, RCH_2·, formed by reaction of O^- with the methyl group of thymine or 5-methylcytosine anions). Specific structures are suggested for the radicals for each of the pyrimidine bases, and spectra are tentatively assigned to these structures. Long-term radical decay is frequently obscured by formation of intermediate and permanent absorbing products. Available data are consistent with decay by second-order processes with $2k \sim 2 \times 10^9$ M^{-1} sec^{-1} at pH 7, and somewhat less at higher pH. (auth)

31353 CONDUCTOMETRIC PULSE RADIOLYSIS OF SULFUR HEXAFLUORIDE IN AQUEOUS SOLUTIONS. RATE OF HYDROLYSIS OF SULFUR TETRAFLUORIDE. Asmus, K.-D.; Gruenbein, W.; Fendler, J. H. (Hahn-Meitner Institut fuer Kernforschung, Berlin. Carnegie-Mellon Univ., Pittsburgh). J. Amer. Chem. Soc.; 92: 2625-8(6 May 1970).

Changes in the conductivity of pulse-irradiated aqueous solutions saturated with SF_6 (ca. 2×10^{-4} M) were observed as a function of time. In neutral solutions the conductivity increased in two steps. The fast first step is attributed to the reactions $e^-_{aq} + SF_6 \rightarrow \cdot SF_5 + F^-$ and $\cdot SF_5 + 2H_2O \rightarrow \cdot OH + SF_4 + H_3O^+ + F^-$. A lower limit for the rate constant of the reaction of $\cdot SF_5$ with with H_2O of 6.3×10^3 M^{-1} sec^{-1} could be derived. The slow second step is due to the hydrolysis of SF_4. The observed pseudo-first-order rate constant for this reaction increased linearly with hydronium and hydroxide ion concentration and can be described by $k_\phi = k_0 + k_a[H_3O^+] + k_b[OH^-]$. The rate constant k_0 for the pH-independent hydrolysis is 9.5×10^3 sec^{-1}, and k_a and k_b for the acid- and base-catalyzed hydrolyses are 8.5×10^7 M^{-1} sec^{-1} and 7.0×10^9 M^{-1} sec^{-1}, respectively. Mechanisms for the hydrolysis of SF_4 are discussed. (auth)

31354 PULSE RADIOLYSIS OF NUCLEIC ACID CONSTITUENTS AND RELATED COMPOUNDS. II. RESOLUTION OF A RAPIDLY DECAYING TRANSIENT ABSORPTION IN CYTOSINE SOLUTIONS. Myers, L. S. Jr.; Warnick, Aida; Hollis, Mary Lynn; Zimbrick, J. D.; Theard, L. M.; Peterson, F. C. (Univ. of California, Los Angeles. Gulf General Atomic Inc., San Diego, Calif.). J. Amer. Chem. Soc.; 92: 2871-4(6 May 1970).

Pulse radiolysis (10-MeV electrons) of N_2O-saturated 5×10^{-4} M aqueous cytosine solutions, pH 10.8 to 12, results in a transient species that decays with a half-life of the order of 1 μsec. The decay follows pseudo first-order kinetics and the half-life varies inversely with the OH^- concentration. The spectrum 1 μsec after the radiation pulse consists of two components. One resembles the spectrum obtained by addition of OH· to cytosine at pH 7. The other is similar to the spectrum obtained at pH 12.6 by reaction of cytosine with O^- anion radical or of cytosine anion with OH· free radical. When decay of the short-lived transient is complete the spectrum is like the pH 12.6 spectrum. The short-lived transient is attributed to ionization of the cytosine-hydroxyl free-radical adduct by reaction with OH^- ion with a second-order rate constant $k = 3.5 \times 10^8$ M^{-1} sec^{-1}. An upper limit for the value of the pK for the ionization reaction is established as 10.7. (auth)

31355 PULSE RADIOLYSIS OF NUCLEIC ACID CONSTITUENTS AND RELATED COMPOUNDS. I. OPTICAL SPECTRUM AND REACTIVITY OF THE 5,6-DIHYDROTHYMINYL FREE RADICAL. Myers, L. S. Jr.; Theard, L. M. (Univ. of California, Los Angeles. Gulf General Atomic Inc., San Diego, Calif.). J. Amer. Chem. Soc.; 92: 2868-70(6 May 1970).

Dilute aqueous solutions of dihydrothymine, saturated with N_2O, were irradiated at pH 6.8 and 1.0 with submicrosecond pulses of 10-MeV electrons, and changes in optical absorbance were observed for periods up to 800 μsec in the wavelength range 300 to 600 nm. A broad absorption band with a maximum at 400 nm was assigned to the 5,6-dihydrothyminyl (probably the 5-yl) free radical. This absorption was also observed on reaction of H· with thymine, but not on reaction of e^-_{aq} with thymine and subsequent protonation of the anion radical. The dihydrothymin-5-yl radical is stable with respect to intramolecular reactions and decays by second-order kinetics with $2k = 2.35 \times 10^9$ M^{-1} sec^{-1} at pH 6.8 and 1.3×10^9 at pH 1.0. The slower decay in acid solutions is consistent with partial protonation of the radical. (auth)

31356 RADIOINDUCED REACTIONS OF 1,3-CYCLOHEXADIENE. Penner, Thomas L.; Whitten, David G.; Hammond, George S. (California Inst. of Tech., Pasadena). J. Amer. Chem. Soc.; 92: 2861-7(6 May 1970).

Irradiation of 1,3-cyclohexadiene with γ rays leads to dimerization either in solution or in the neat liquid. Relative amounts of the products vary widely with reaction conditions but the composition of the mixtures can be expressed as consisting of variable amounts of two groups. One set of products corresponds to those formed in thermal dimerization and the other has the distribution found in photodimerization mediated by triplet sensitizers. Formation of the "thermal" dimers is inhibited by isopropyl alcohol, a cation scavenger, and promoted by electron scavengers so a cationic mechanism is postulated. Ring cleavage to give 1,3,5-hexatriene is also observed and attributed to an excited singlet state of the diene. Since ring opening is not affected by electron scavengers we infer that excited singlets are formed in primary excitation processes and that triplets are produced by charge neutralization. (auth)

31357 RADIOLYSIS OF LIQUID n-PENTANE. Bishop, William P.; Firestone, Richard F. (Ohio State Univ., Columbus). J. Phys. Chem.; 74: 2274-84(28 May 1970).

Effects of irradiation temperature, I_2 concentration, and dose in the presence and absence of I_2 on the 100-eV yields of the forty more abundant radiolysis products ($G \geq 0.001$) have been determined quantitatively and are interpreted in detail. Dose dependency is absent for all products of initially pure pentane, except ethylene, below 3×10^{20} eV/g. Homogeneous free-radical reactions account for 53% of pentane consumed at 25°. Abstraction steps consumed 12%, and combination and disproportionation steps account for 41% of pentane consumed at 25°. The 100-eV yields of homogeneous 1-pentyl, 2-pentyl, 3-pentyl, butyl, propyl, ethyl, and methyl radicals have been determined at 25° and −78°C from measured decrements in hydrocarbon product yields caused by the presence of I_2 and by variation of irradiation temperature. Excellent agreement has been observed for yields of all except 1-pentyl radicals with those determined by the $^{14}C_2H_5$ radical sampling method. The C_6 to C_{10} alkene products appear to be formed by thermal pentenyl radicals, whose primary radiolytic yield is 0.06 radical/100 eV. $G(H_2)$ equals 4.2 molecules/100 eV at 25° and is independent of dose below 10^{21} eV/g. The 100-eV yield of thermal H atoms is estimated to be 0.7 ± 0.2 atom/100 eV from effects of temperature on $G(H_2)$. It is also shown that inhibition of "molecular" H_2 by I_2 is not accompanied by inhibition of the yields of pentenes or other hydrocarbon products. (auth)

31358 FLUORESCENCE OF LIQUID BENZENE UNDER PROTON AND ELECTRON IMPACT. West, M. L.; Nichols, L. L. (Battelle Memorial Inst., Richland, Wash.). J. Phys. Chem.; 74: 2404-6(28 May 1970).

Fluorescence spectra are shown for liquid benzene and benzene–cyclohexane mixtures at room temperature under proton and electron impact. In addition to the singlet monomer fluorescence, several fluorescing radiolysis products were observed. Some explanations of the types of products contributing to this fluorescence is offered. (B.L.M.)

31359 PULSE RADIOLYTIC INVESTIGATIONS ON THE OXIDATION OF UNSATURATED CARBONYL COMPOUNDS IN AQUEOUS SOLUTION: HYDRATED ENOL AS INTERMEDIATE PRODUCT. Lilie, J.; Henglein, A. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Ber. Bunsenges. Phys. Chem.; 74: 388-93(Apr 1970). (In German).

The OH radical adds to the double bonds of vinyl methyl ketone, acrolein, and crotonaldehyde at a diffusion-controlled rate. The spectra of the resulting C radicals were determined. The radicals produced from vinyl methyl ketone and acrolein disproportionate with 30% probability to form the enols of acetoacetaldehyde and of malondialdehyde, respectively. The radicals formed from crotonaldehyde disproportionate with 86% probability to yield the enol of acetoacetaldehyde. When the OH radical adds to the hydrated form of crotonaldehyde, the hydrated enol of acetoacetaldehyde is finally formed. The rate constant for the spontaneous dehydration of this molecule was found to be $54s^{-1}$. The process of dehydration is catalyzed by OH^- ions in alkaline solutions. The pK of the hydrated enol was found to be 11.6. The rate constant of the spontaneous dehydration of the hydrated enol anion is $10 \cdot 10^4 s^{-1}$. The rate constant and activation energy for the spontaneous dehydration of the enol of malondialdehyde were respectively 40 sec^{-1} (20°C) and 7.7 kcal/mol. (auth)

31360 PULSE RADIOLYTIC INVESTIGATION OF $ISCN^-$ AND I_2SCN^- COMPLEXES. Schoeneshoefer, M.; Henglein, A. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Ber. Bunsenges. Phys. Chem.; 74: 393-8(Apr 1970). (In German).

$ISCN^-$ is formed as an intermediate when thiocyanate ions and iodide ions are simultaneously oxidized in aqueous solution. $ISCN^-$ has an absorption maximum at 4200 Å with $\epsilon_{max} = 9.2 \cdot 10^3$ M^{-1} cm^{-1}. The equilibria $ISCN^- + SCN^- \rightleftharpoons \cdot I^- + (SCN)_2^-$ and $ISCN^- + I^- \rightleftharpoons I_2^- + SCN^-$ are rapidly attained. The equilibrium constants are $2.5 \cdot 10^{-3}$ and 55, respectively. $ISCN^-$ dissociates in the two equilibria $ISCN^- \rightleftharpoons I^- + SCN$ and $ISCN^- \rightleftharpoons I + SCN^-$, which have equilibrium constants of $1.3 \cdot 10^{-8}$ M and $4.8 \cdot 10^{-4}$ M, respectively. I_2SCN^- is formed during the disappearance of the complexes I_2^-, $ISCN^-$, and $(SCN)_2^-$. I_2SCN^- has an absorption maximum at 3000 Å with $\epsilon_{max} = 3.7 \cdot 10^4$ M^{-1} cm^{-1}. The equilibrium constant for the dissociation $I_2SCN^- \rightleftharpoons I_2 + SCN^-$ is $1.5 \cdot 10^{-2}$ M. (auth)

31361 ^{18}F PRODUCTION FOR MEDICAL USE BY ^3He BOMBARDMENT OF WATER. Tilbury, Roy S.; Dahl, J. Robert; Mamacos, James P.; Laughlin, John S. (Sloan-Kettering Inst. for Cancer Research, New York). Contract AT(30-1)-910. Int. J. Appl. Radiat. Isotop.; 21: 277-81(May 1970).

A method is described for the production of ^{18}F as fluoride ion in aqueous solution. Pure water (10 ml) is irradiated with 22-MeV ^3He ions from an isochronous cyclotron. The yield is 6 mCi/μAh or 70 mCi in 30 min with a beam current of 25 μA. Impurities are so low ($<10^{-5}$) that it is not necessary to remove them chemically. Saline is added to make the solution isotonic, it is then sterile filtered and ready for injection. (auth) (UK)

31362 PROCEEDINGS OF THE 9th JAPAN CONFERENCE ON RADIOISOTOPES, MAY 13–15, 1969, TOKYO, JAPAN. Tokyo; Japan Atomic Industrial Forum, Inc. (1969). 1092p. (In Japanese and English). (CONF-690548).

Two hundred six papers are included; separate abstracts were prepared for 183. Nineteen of the remaining 23 papers were not in scope for NSA and no English translation was included for four of the papers. (P.C.H.)

For abstracts of individual papers see: 31231, 31232, 31246–31248, 31271–31283, 31321–31324, 31363–31407, 31453–31457, 31477–31481, 31528, 31569–31573, 31603–31613, 31663–31665, 31687–31707, 31721–31724, 31740–31742, 31750–31754, 31756, 31757, 31776–31790, 31819–31823, 31849, 31896, 31897, 31912, 31999, 32020, 32066–32071, 32248, 32310–32313, 32355, 32356, 32452, 32525, 32614, 32903, 32934, 33074–33078, 33112, and 33137.

31363 STATUS OF UNITED STATES PROGRAM ON ISOTOPES AND RADIATION DEVELOPMENT. Ballantine, D. S. (Atomic Energy Commission, Washington, D. C.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 14-20(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A review is presented on radiation research and development and on production and uses of radioisotopes in various fields in the U. S. The various uses mentioned include: radioisotopes in medicine; auxiliary electric power production; power source for artificial heart devices; thermal systems application for aerospace and oceanography; radioisotope heaters for the Apollo 11 mission; pollution control; radiation treatment of wastewater; and use of radiation for development of an improved concrete product. (P.C.H.)

31364 RECENT TRENDS IN PRODUCTION AND UTILIZATION OF RADIOISOTOPES IN FRANCE. Fisher, Ch. (CEA, Paris). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 21-6 (1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The rate of increase of radioisotope production in France together with an indication of the most recent technical developments such as new radiopharmaceuticals, large sources for industrial irradiation, recovery of fission products, and manufacturing of heat sources for isotopic generators are discussed. Utilization of radioisotopes is reviewed, and figures are given for different types of applications in the medical and industrial fields. New developments in industrial applications are emphasized, with special attention given to: hydrology and siltation studies; x-ray fluorescence; activation analysis; radiation utilization in sterilization, food preservation and production of wood–plastic materials; and thermoelectric isotope generators. (auth)

31365 DEVELOPMENT IN THE PRODUCTION TECHNIQUES FOR ^{82}Br. Shibata, Nagao; Mochizuki, Tsutomu; Amano, Hiroshi; Ito, Taro; Iguchi, Akira; Arai, Michimasa (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 35-7(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A procedure for the production of bromine-82 of high specific activity in the chemical form of sodium bromide has been developed. The specific activity was improved to more than 0.15 Ci/g of bromine, about ten times that of the former product, by substituting the former target material of ammonium bromide with potassium bromide and lengthening the irradiation period up to more than 180 hours. The byproduct bromine-80m activity was eliminated by cooling for four days after irradiation. The conversion of the chemical form from potassium bromide to sodium bromide was achieved by treating the dissolved target material with a sodium labeled cation exchanger instead of passing the solution through two steps of column successively. Another radiochemical impurity that affected the final product was sulfur-35 introduced from chlorine impurity, and its amount could be reduced to less than 0.01% by selecting the target material that contained less than 40 ppM chlorine. The routine production scheme adopted is as follows: target: 0.2 g of spectrometrically pure potassium bromide; irradiation: VR-2-10 irradiation hole of JRR-3 ($1 \times 10^{13} n/cm^2 \cdot sec$), 240 hours; chemical procedure: cool for 4 days after irradiation, dissolve in water, and then convert potassium bromide to sodium bromide by passing through sodium labeled cation exchanger. (auth)

31366 THE TECHNICAL PROBLEMS ON THE ROUTINE PRODUCTION OF ^{51}Cr IN A HIGH SPECIFIC ACTIVITY UTILIZING THE SZILARD–CHALMERS METHOD. Shibata, Nagao; Mochizuki, Tsutomu; Tanaka, Kichizo; Ebihara, Hiroshi; Kurosawa, Kiyoyuki; Kato, Mineo (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 38-40(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The basic problems concerning the chemical distribution of ^{51}Cr species produced in heavily irradiated potassium chromate were studied in relation to the effects of the composition of the solvent. On the basis of the results, a new processing method and new apparatus were established and several test productions were made. The results were found to be satisfactory for a production capacity of 500 mCi per batch (approximately 5 Ci per year). (P.C.H.)

31367 ROUTINE PRODUCTION OF ^{64}Cu IN A HIGH SPECIFIC ACTIVITY UTILIZING THE SZILARD–CHALMERS METHOD. Shibata, Nagao; Mochizuki, Tsutomu; Tanaka, Kichizo; Ebihara, Hiroshi; Kurosawa, Kiyoyuki; Kato, Mineo (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 41-3(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

An efficient method is described for the production of ^{64}Cu by the Szilard–Chalmers reaction on copper phthalocyanine in which as much as 100 mCi per batch is produced. It was found that the production yields were directly affected by changes in the process and the apparatus, which are discussed. (P.C.H.)

31368 PRODUCTION OF ^{99m}Tc FROM IRRADIATED MOLYBDENUM OXIDE OF LOW SPECIFIC ACTIVITY. Shibata, Nagao; Mochizuki, Tsutomu; Amano, Hiroshi; Nakamura, Haruto; Tachimori, Shoichi (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 44-6(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A method for the production of ^{99m}Tc from ^{99}Mo of low specific activity obtained by low neutron flux ($\sim 10^{13}$ n/cm^2·sec) irradiation is described. Two methods were studied for processing the irradiated target. The method selected involves the dissolution of the irradiated target in NaOH solution and treatment with 2-butanone to extract Tc. The extracted Tc is purified using a cation exchanger and alumina column, successively, followed by elution with HCl or saline solution. (P.C.H.)

31369 CHEMICAL BEHAVIOR OF RECOIL ATOMS PRODUCED BY LOW TEMPERATURE IRRADIATION. Yeh, Si Jung (National Tsing Hua Univ., Hsinchu, Taiwan); Shibata, Nagao; Amano, Hiroshi; Yoshihara, Kenji; Yang, Mo-hsiung; Chen, Ping Yao; Chen, Tasai Fong; Chen, Chin Tsang; Ke, Chin Nan; Kudo, Hiroshi. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 53-5 (1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Several chromate compounds were neutron irradiated at a low temperature, and the irradiated samples were dissolved in a eutectic mixture of LiCl–H_2O and separated into fractions of ^{51}Cr(III) and ^{51}Cr(VI) by the lanthanum coprecipitation method. The radioactivity of ^{51}Cr was measured by a single channel γ spectrometer. Values for initial retention are tabulated. The retention of Na and Mg salts was decreased by the presence of water of crystallization. The effects of annealing are also discussed. (P.C.H.)

31370 ELECTRON SPIN RESONANCE OF IRRADIATED POLYCARBONATE. Hama, Yoshimasa; Shinohara, Kenichi (Waseda Univ., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 183-5(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

ESR studies were made on free radicals produced in γ- and uv-irradiated polycarbonates. The results showed that in the γ-irradiated specimen, the energy was absorbed at random by the material and several kinds of free radicals were produced by the scission of the carbonate group. In the uv-irradiated samples, the energy was absorbed selectively by the carbonate group in the surface region of the sample and the scission of carbonate group produced free radicals. (P.C.H.)

31371 RADIOLYSIS IN NAPHTHALENE SINGLE CRYSTAL. Itoh, Horiaki (Nagoya Univ., Japan); Okubo, Takenori. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 186-8(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

EPR and optical spectral studies were made on x- and electron-irradiated naphthalene monocrystals. The results showed that the hydronaphthyl radical was produced by irradiation at every temperature between liquid nitrogen and room temperature. The naphthyl radical and the hydronaphthyl radical were produced in pairs by irradiation at liquid nitrogen temperature. The naphthyl radical was not stable during irradiation above dry ice temperature. It is suggested that a naphthyl radical reacts with a neighboring molecule during irradiation above dry ice temperature and that the final reaction product at room temperature is dimer molecules. The naphthyl radical yield decreased as the temperature increased. (P.C.H.)

31372 RADIOCHEMICAL STUDIES OF PROTEIN REACTIONS: EFFECT OF ADDED SUBSTANCES ON VISCOSITY. Nishizawa, Mizuho. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 189-90(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The effects of γ radiation on the viscosity of albumin in urea solutions containing added substances were studied. Variations in the effects of the added substances are discussed. The added substances consisted of amino acids, proteins, chelating agents, and organic sulfur compounds. It was concluded that the effect of the added substance on the viscosity was related to its inhibition of the unfolding reaction of albumin. (P.C.H.)

31373 RADIATION DECOMPOSITION OF IODINE–AMYLOSE COMPLEX. Chiba, Yoshiro; Shimojima, Hikaru (Nippon Atomic Industry Group Co., Ltd., Kawasaki, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 191-3(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the effects of alcohol and potassium iodide on the γ radiolysis of iodine complex with amylose. Blue shifts in the absorption spectrum were observed in the presence of alcohol. The G-value of the decomposition reaction gradually decreased with increasing alcohol, and was 14.8% with 40% alcohol. In the presence of potassium iodide, slight blue shifts of the absorption spectrum were observed, and absorption of I_3^- at 353 mμ increased with irradiation. The G-value of the decomposition was -8.82×10^{-3}. For comparison, the radiodecomposition of aqueous amylose solution without additions was found to be –2.13. (P.C.H.)

31374 POST CROSSLINKING OF POLYSTYRENE-FORMED MATERIALS BY IRRADIATION. Itoh, S.; Ohnishi, S.; Yamauchi, A.; Yamamoto, S. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 194-6(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Polystyrene films were immersed in mixed solutions of methanol and diene monomer isoprene and butadiene in glass tubes. By controlling the monomer concentration, the polymers were kept insoluble in mixed solution. Methanol was used as a shape-keeping reagent and a solvent for diene monomer. The films absorbed diene monomer, and, after γ irradiation, crosslinked films showed no shrinkage and swelling. Bands at 1662, 1640, and 882 cm^{-1} assignable to C=C double bond were observed in the ir spectra of crosslinked films. The bands at 2851 and 1450 cm^{-1} for $-CH_2$, 1376 cm^{-1} for $-CH_3$, and 838 cm^{-1} for C=C double bond increased in intensity, while the bands at 1602 and 760 cm^{-1} decreased in intensity. (P.C.H.)

31375 RADIATION GRAFTING OF HYDROPHILIC MONOMERS TO POLYESTER FIBERS. Okada, Toshio; Suzuki, Yasuo; Kohdera, Kanako; Sakurada, Ichiro (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 197-9(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the γ-radioinduced graft polymerization of 4-vinylpyridine–acrylic acid onto polyethylene terephthalate fibers. Carbon tetrachloride was found to have a sensitizing effect on the grafting. After-treatments, such as drawing and heat treatment, were found to improve the mechanical and thermal properties of the grafted fibers. (P.C.H.)

31376 ELECTRON SPIN RESONANCE STUDY OF FREE RADICALS IN THE RADIATION GRAFTING FROM IRRADIATED POLYETHYLENE. Seguchi, Tadao; Tamura, Naoyuki (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 200-2(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

ESR spectral studies were made on the behavior of trapped radicals and their reactivity with methyl methacrylate (MMA) in the electron-radioinduced graft polymerization of polyethylene with MMA. It was concluded that alkyl radicals do not react with MMA directly, but convert into allyl radicals, which react with MMA. Since the rate of allyl–MMA transfer reaction is faster than the rate of alkyl–allyl conversion, the apparent reaction of the alkyl radicals with MMA was observed. The kinetics of decay and growth of radicals and the effects of crystallinity and molecular mobility are discussed. (P.C.H.)

31377 ACCELERATING EFFECT OF ACETYLENE ON THE γ-RADIATION-INDUCED CROSS-LINKING OF POLYETHYLENE. Mitsui, Hiroshi; Hosoi, Fumio; Kagiya, Tsutomu (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 203-5(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the effects of acetylene on hydrogen formation and changes in solubility and structure of the polymer produced by γ-radioinduced polymerization of polyethylene. The role of acetylene in the crosslinking was also elucidated. The results showed that the presence of acetylene had little effect on the amount of hydrogen formed, which tended to increase gradually with irradiation temperature. The gel fraction of polyethylene irradiated in the presence of acetylene increased with temperature in the range of 30 to 90°C, passed through a maximum at around 90 to 100°C, and thereafter decreased remarkably to become almost constant at above the melting temperature of polyethylene (about 120°C). On the basis of the results, a mechanism of the γ-radioinduced crosslinking of polyethylene caused by acetylene is proposed. (P.C.H.)

31378 RADIATION-INDUCED REACTION BETWEEN 1,2-BUTYLENE OXIDE AND CHLOROETHYLENES. Yumoto, Takaari; Matsuda, Tatsuo (Government Industrial Research Inst., Nagoya, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 206-8(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the γ-radioinduced reactions between 1,2-epoxybutane and tetrachloroethylene, trichloroethylene, or cis-dichloroethylene. The reactions produced mainly chlorohydrin and telomer (n = 2). The decreasing order in apparent reactivity of chloroethylene was: $CCl_2=CCl_2 > CCl_2=CClH >$ cis-CHCL = CHCl. A mechanism for the formation of the products is suggested. Data on the properties of the products formed are tabulated. (P.C.H.)

31379 REACTION INTERMEDIATES PRODUCED FROM NITRILES IN γ-IRRADIATED ORGANIC GLASSES AT 77°K. Fueki, K.; Kuri, Z.; Ochiai, M. (Nagoya Univ., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 267-9(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

ESR and optical studies were made on reaction intermediates produced by γ irradiation of nitriles in tetrahydromethylfuran (MTHF) glass at 77°K. Measurements were also made on secondary intermediates produced from primary intermediates by illuminating γ-irradiated samples with visible light. The nitriles studied were aceto-, propio-, n-butyro-, isobutyro-, n-valero-, acrylo-, and benzonitrile. The ESR spectrum exhibited a singlet superimposed on the central part of a septet. The singlet and septet spectra are attributed to trapped electrons and MTHF radicals, respectively. The intensity of the singlet decreased with increasing concentration of nitriles. The results indicate that nitriles compete with the solvent for capturing electrons. Illumination of γ-irradiated samples with visible light caused the ESR spectrum to change; the singlet disappeared and a new spectrum appeared. (P.C.H.)

31380 PRODUCTION OF TRIPLET STATE MOLECULES. Higashimura, Takenobu (Kyoto Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 270-1(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A brief review is presented on methods and studies on the production of triplet state molecules by radiation. (P.C.H.)

31381 PULSE RADIOLYSIS OF TRANS-STILBENE SOLUTION. Ueda, Hisashi (Tokyo Kogyo Shikenjo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 272(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Pulse radiolysis studies were made on trans-stilbene in 1,1-dichloroethane and tetrahydro-2-methylfuran (MTHF) in an attempt to establish the formation and decay of the radiation chemical transient species in a solution of an aromatic hydrocarbon in an alkyl halide solvent in the liquid phase. The results showed that there was no considerable difference between the spectrum in MTHF and that in 1,1-dichloroethane. The only difference was the position of the absorption maximum, which was at 500 mμ for MTHF and at 490 mμ for 1,1-dichloroethane. The effects of added N_2O, SO_2, NH_3, and CCl_4 were studied, and it was found that the transient species formed in 1,1-dichloroethane were not affected much by any added N_2O or SO_2, but completely disappeared if NH_3 was added. The mechanism for the reactions involved is discussed. (P.C.H.)

31382 PULSE RADIOLYSIS OF STYRENES. Katayama, M.; Yamazaki, H.; Ozawa, Y.; Ogasawara, M. (Hokkaido Univ., Sapporo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 273-5 (1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the nature and reactions of transient species in the electron pulse radiolysis of styrene and α-methylstyrene. The existence of an anion radical from α-methylstyrene, formed by electron trapping by the monomer molecule, was found in the transient absorption spectrum. The results were in good agreement with similar studies by others. (P.C.H.)

31383 REACTIVITY OF GROWING CHAIN RADICALS IN THE ETHYLENE POLYMERIZATION INDUCED BY γ-RAY COMPARED WITH 2,2′-AZOBISISOBUTYRONITRILE. Hagiwara, Miyuki; Okamoto, Hidemasa; Kagiya, Tsutomu (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 276-8(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A comparison was made of the reactivity of radicals produced by γ- and 2,2′-azobisisobutyronitrile (AIBN)-induced polymerization of ethylene. The average molecular weight of the polymer formed was determined by intrinsic viscosity measurements. In the radioinduced polymerization, radiolysis products, such as C_2H_2 and H_2, were produced during the course of the reaction. N_2 and $(C_3H_6CN)_2$ were produced as by-products in the AIBN-induced polymerization. From the results it was concluded that growing radicals with a different reactivity were produced in both polymerizations. (P.C.H.)

31384 γ-RAY INDUCED SOLUTION COPOLYMERIZATION OF ETHYLENE WITH HALOGENATED VINYL MONOMERS. Hagiwara, Miyuki; Miura, Takeshi; Kagiya, Tsutomu (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 279-81(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The γ-radioinduced polymerization of ethylene with vinyl chloride or tetrafluoroethylene in various solvents was studied at room temperature. The effects of monomer composition on the rate of copolymerization and molecular weight of the copolymer formed were considered, along with the variation of the rate and molecular weight in different solvents. The mechanism of the copolymerization is discussed from the point of kinetics. The variation of the structure of the copolymers with their composition is also reported. The results showed that a very small amount of vinyl chloride has a pronounced inhibiting effect on the copolymerization. It was also found that the copolymerization reaction was strongly promoted by using some fluorocarbons, such as 1,2-dichlorotetrafluoroethane and monochloropentafluoroethane, as solvents. The rate and molecular weight increased linearly with the amount of solvent. (P.C.H.)

31385 RADIOINDUCED COPOLYMERIZATION OF ETHYLENE WITH TETRAFLUOROETHYLENE. Ito, W.; Tabata, Y.; Oshima, K. (Tokyo Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 282-5(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The effects of solvents, temperature, radiation intensity, and other reaction conditions on the radioinduced polymerization of ethylene with tetrafluoroethylene were studied. In bulk polymerization, the rate was proportional to the square root of dose rate, suggesting a bimolecular reaction. Activation energy of the polymerization in various molar ratios of monomer mixtures was found to be in the region of 4.1 to 5.0 kcal/mole. In solution polymerization, the results indicated that freon-type solvents were excellent for the polymerization in comparison with other solvents. The rate of polymerization was approximately proportional to the square root of dose rate as in bulk polymerization. The tensile strength and elongation polymer products were greatly affected by the polymerization conditions. (P.C.H.)

31386 PILOT SCALE STUDY OF RADIOINDUCED POLYMERIZATION OF ETHYLENE. I. POLYMERIZATION IN WET WALL PROCESS. Takehisa, Masaaki (Japan Atomic Energy Research Inst., Tokyo); Kurihara, Hirondo; Takasaka, Yoshio; (and others). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 286-8(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

On the basis of preliminary considerations and experiments, a modification was made in the pilot plant from gas phase bulk polymerization to a wet wall process with the aim of continuous removal of polyethylene from the reaction zone to atmospheric pressure as a thin slurry and also for prevention of adhesion of polyethylene onto the reactor wall. The outline of the modified pilot plant and the results obtained on the γ-radioinduced polymerization are described. The modifications consisted of: replacement of the reactor from bulk polymerization reactor to an overflow type wet wall reactor of 10 l; removal of one of the high-pressure separators; addition of thin long pipe as a pressure reducing means of the slurry produced; addition of filters for polyethylene recovery; and addition of a solvent pump. (P.C.H.)

31387 PILOT SCALE STUDY OF RADIOINDUCED POLYMERIZATION OF ETHYLENE. II. PHYSICAL PROPERTIES AND STRUCTURE OF POLYETHYLENE FORMED IN WET WALL PROCESS. Takehisa, Masaaki (Japan Catalitic Chemical Co., Tokyo); Yamaguchi, Koichi; Machi, Sueo; Sugo, Takanobu; Konishi, Kunio; Wada, Takeshi; Toyota, Nobuhiro. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 289-91(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The physical properties and structure of polyethylene produced by a new pilot plant, using the wet wall reactor in the presence of aqueous 2-methyl-2-propanol solutions, are described. Several properties of the polyethylene produced by a wet wall process were also compared with the physical properties of polyethylene produced by the bulk process. IR spectral studies indicated that a

radical produced by γ radiolysis of 2-methyl-2-propanol acts as the major initiating species of the polymerization. The values of yield strength, tensile strength, elongation at break, and stiffness were comparable to those of the bulk process polymer and of the conventional polyethylenes. (P.C.H.)

31388 RADIOINDUCED POLYMERIZATION OF TRIOXANE. Ito, Akihiko; Iwai, Tadashi; Ishigaki, Isao; Sakamoto, Masahiro; Kumakura, Minoru; Yoshida, Masaru; Yamasawa, Yuzo; Hayashi, Koichiro; Okamura, Seizo (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 292-4(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the γ-radioinduced postpolymerization of trioxane on a pilot plant scale to determine the most suitable conditions for operating the plant. The polymer yield and molecular weight were investigated as a function of preirradiation dose, temperature, and time. From the results it was found that in the polymerization temperature range of 45 to 55°C, the higher the temperature, the larger the initial rate of polymerization. The initial rate of polymerization increased with an increase in preirradiation dose in the range of 1.4×10^5 to 1.3×10^6 R. However, the molecular weight of the polymer became lower with an increase in preirradiation dose. (P.C.H.)

31389 PILOT SCALE STUDIES OF RADIOINDUCED POLYMERIZATION OF TRIOXANE. Ito, Akihiko; Iwai, Tadashi; Tamura, Takao; (and others) (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 295-7 (1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The results of pilot scale postpolymerization of trioxane are discussed and compared with the results of basic research. The effects of polymerization time, irradiation dose, and dose rate on polymer yield and molecular weight, and a possibility of industrial plant production were investigated. Trioxane was converted to polymer at about 65% yield after irradiation with 1 MRad electron beams and aging at 55°C for 5 hr. The effects of radiation dose on the yield and molecular weight of the polymer in the pilot scale experiments agreed closely with the results of basic research in the range of 0.5 ~ 2 MRad. The effects of dose were negligible in the range of 0.1 ~ 0.7 MRad/sec. (P.C.H.)

31390 ACETYLATION OF POLYOXYMETHYLENE PREPARED BY RADIOINDUCED POLYMERIZATION OF TRIOXANE. Ito, Akihiko; Iwai, Tadashi; Okubo, Hiroshi; Watanabe, Yuhei; Yamashina, Hisao; Tsuji, Tadashi; Hayashi, Koichiro; Okamura, Seizo. (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 298-300(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the acetylation of polyoxymethylene (POM), effects of crystallinity on the rate of the acetylation reaction of POM, and conditions for acetylation of POM. The effects of acetic acid contained as impurity in acetic anhydride, which was used as the acetylating reagent, were also studied. During the acetylation reaction the intrinsic viscosity of POM was lowered by main chain cleavage. The effects of acetic acid on main chain cleavage became appreciable in the case of high concentrations of acetic acid. The intrinsic viscosity of the polymer decreased less sharply in benzene compared with that in acetic anhydride at the same concentration of acetic acid. However, the decrease in the intrinsic viscosity at low acetic acid concentration was attributed to factors other than acetic acid. DTA measurements on the temperature of dissolution of POM in benzene containing various concentrations of acetic acid showed that benzene containing small amounts of acetic acid dissolved the polymer more easily than pure benzene. (P.C.H.)

31391 BAMBOO-PLASTIC COMBINATIONS BY USE OF GAMMA RADIATION. Yuan, H. C.; Wang, Ung-ping (Union Industrial Research Inst., Hsinchu, Taiwan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 307-18(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Vinyl monomers, such as vinyl acetate, methyl methacrylate, styrene, or mixtures of monomers, were polymerized without catalysts in Taiwan-produced bamboo materials, including variety bamboo, Taiwan giant bamboo, long branch bamboo, moso bamboo, makino bamboo, and thorny bamboo, by γ radiation. The superior properties of the bamboo–plastic combinations are listed. Moisture content, essential oils, irradiation ambient gas atmosphere, and swelling agents were found to have distinctive effects on the polymerization of vinyl monomers in bamboo constituents. The relation between polymerization and γ dose rate was also studied. The results are presented in graphic form. (P.C.H.)

31392 RADIATION SYNTHESES OF NEW MATERIALS AT ATOMIC ENERGY OF CANADA LIMITED. DasGupta, Sharda (Atomic Energy of Canada Ltd., Chalk River, Ont.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 319-27(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Developments in the use of ^{60}Co γ radiation for the modification of natural materials, synthesis of graft copolymers useful in the textile industry, and imparting of useful characteristics to common industrial materials are described. Graft polymers of cotton were prepared using vinyl or vinylidene monomers either singly or as mixtures. The products showed vast improvements in many properties. Between 200 to 300% increase in wet mechanical strength for paper was achieved by grafting styrene and acrylonitrile. By grafting suitable monomers onto nylon fibers and fabrics, soil resistance and weather-proofing properties have been imparted. The radiation resistance of many commercial lubricants has been increased by a factor of up to 250 by relatively simple procedures. (P.C.H.)

31393 RADIOINDUCED POLYMERIZATION OF VINYL CHLORIDE–VINYL ACETATE SYSTEM WITH BAMBOO. Yuan, H. C. (International Atomic Energy Agency, Vienna). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 328-33(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the γ-radioinduced polymerization of vinyl chloride–vinyl acetate mixture impregnated in six different types of bamboo. The addition of swelling agent was found to reduce the total dosage required. In the presence of 10% ethanol, the polymerization was completed with 1 MRad for variety bamboo. An increase of 60% in tensile strength was found in the samples containing 35% polymer as compared with the original bamboo. The hardness was almost doubled and the water absorption percentage was reduced to 15% after 60 days of immersion. (P.C.H.)

31394 UPGRADING OF WOOD AND FIBER BOARDS BY IMPREGNATION OR COATING WITH POLYESTER/STYRENE MIXTURES AND CURING EITHER WITH RADIATION OR WITH PEROXIDES AND HEATING. Miettinen, Jorma K.; Autio, Timo (Univ. of Helsinki). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 334-42(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A brief summary of four years of research on wood plastic combinations is given. The results of large scale tests of four Finnish wood species (birch, alder, aspen, and pine) impregnated with methyl metacrylate or polyester–styrene and tested for ten physical properties are described. Results obtained with preliminary tests with 36 Far Eastern wood species impregnated with polyester/styrene are also reviewed. Polyester resin mixtures were found to be much cheaper than methyl metacrylate (MMA) and gave results that were as good or better than those obtained with MMA. (P.C.H.)

31395 ELECTRON BEAM CURING OF PAINT FILMS. Nagai, Akio; Ueda, Kazuhiro; Hiro, Sanju; Asaki, Atsuo; Suzuki, Yasuhiro (Mitsubishi Electric Corp., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 483-5(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The characteristics of the electron irradiation beam used for curing paint films are described. Some model paints composed of a mixture of unsaturated polyester prepolymer and vinyl monomer were cured by electron beam irradiation. The total dose was 1 ~ 10 MRad, and dose rate was 0.01 ~ 2.5 MRad/sec. Viscoelastic properties of the cured films were studied. No difference was found in viscoelastic properties of cured films that were irradiated above 5 MRad. (P.C.H.)

31396 . A STUDY ON ELECTRON CURING OF PAINT FILM. Masuda, Hiromasa (Nippon Oils and Fats Co., Ltd., Mikuni, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 486-9 (1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were made on the radiation curing of paint films on various woods at an accelerating voltage of 2 MeV and a dose of 1 to 15 MRad. It was concluded that the paint film property is highly affected by dose, accelerating voltage, and dose rate. The results were evaluated by gel percent measurements. (P.C.H.)

31397 RADIATION CURING OF DIALLYLPHTHALATE PREPOLYMER AND MONOMER MIXTURES. Gotoda, M.; Tsuji, T.; Takeutsi, T.; Manabe, T.; Kodama, T.; Yokoyama, K. (Japan Atomic Energy Research Inst., Osaka). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 490(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Conditions were studied for the radiation curing of diallyl phthalate prepolymer (DAP_p) with monomers, such as vinyl acetate, methyl methacrylate, methyl acrylate, and acrylonitrile, by high-energy electron beams and ^{60}Co γ rays. The degree of curing was measured by dividing the degree into four classes from null to perfect curing by finger touch. The results showed that the degree of viscosity of DAP_p does not affect the curing dosage. The addition of small amounts of curing catalyst or crosslinking agent can reduce the curing dosage. The electron beam irradiation dose required for curing was, for example, 4 and 3 MRad for mixtures of DAP_p and MMA with a ratio of 1:1 and 3:1, respectively. (P.C.H.)

31398 FAST REACTION STUDIES IN RADIATION CHEMISTRY. Dorfman, Leon M. (Ohio State Univ., Columbus). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 569-70(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies on the reactions of ions of aromatic molecule in solution and the detection and reactivity of the H-atom in gases by fast Lyman-α absorption are discussed. The specific rate of the electron transfer reaction in two-component solute systems was studied as a function of the free energy of the reaction (i.e., reduction potential difference of the pair). The electron transfer reaction in solutions of aromatic compounds in halogenated hydrocarbons was also studied. Pulse radiolysis was combined with fast detection using the Lyman-α line at 1216 Å (H-atom resonance line, $2s \rightarrow 2p$ transition) to study the formation of H-atoms in the gas following an electron pulse, and their subsequent decay in reactions such as $H + O_2 = HO_2$ and others. The preliminary results, obtained to date, are discussed. (P.C.H.)

31399 PULSE RADIOLYSIS STUDIES OF ELECTRON TRANSFER AND PROTONATION. Swallow, A. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 571-9(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Discussion is presented on the effects of oxygen in pulse radiolysis studies and also the mechanism of electron transfer reactions and protonation. The transfer of electrons, protons, and hydrogen atoms in studies of biological interest are also included. (P.C.H.)

31400 RADIATION CHEMISTRY OF ORGANIC GLASSES. Kosa-Somogyi, I. (Central Research Inst. for Physics, Budapest). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 588-97(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The experimental results obtained on polar and nonpolar glasses by the use of dc conductivity measurements, spectrophotometry, and ESR are summarized. Data on methanol, ethanol, and 3-methylpentane (3-MP) are discussed in detail, while those on tetrahydro-2-methylfuran (MTHF) and C_3-C_5 alcohols are discussed only as far as they can be related to molecular structure. Conductivity and radiothermoluminescence measurements made it possible to establish structural transition temperatures characterizing the onset of molecular motions. Direct evidence was obtained on the recombination of trapped charged particles taking place at these temperatures. The concentration of traps, as calculated from optical and ESR data, was found to be of the order of 10^{19} to 10^{20} cm^{-3} and turned out to be preexisting. Activation energies for thermal and optical freeing (bleaching) of trapped charges under irradiation were compared. It was found that radiation enhanced only the thermal bleaching of electrons. The distribution of trap depths was found to be inhomogeneous. The temperature profile of electric conductivity after bleaching indicated that part of the electrons get into a trapped state in which they cannot be detected by ESR but on thermal bleaching they are manifested by an increase in measurable electron current. (auth)

31401 PRACTICAL PRODUCTION OF POLYVINYL ACETATE EMULSIONS BY RADIATION CATALYSIS. Ransohoff, J. A.; Woodard, Dudley G. (Neutron Products, Inc., Washington, D. C.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 598-604(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The pilot plant production of poly(vinyl acetate) emulsions by ^{60}Co γ radiation is described. Although a change in process conditions after three days of a relatively uneventful operation of the pilot plant resulted in coagulation of the reactants, the material produced prior to the change in reacting conditions was evaluated and the properties of the product compared favorably with those of a top quality commercial product. Using a portion of the product, 10 gal of interior flat paint was produced and applied in a variety of pastel colors where it proved to have remarkably effective one-coat coverage. The comparative economics of radiation catalysis and conventional catalysis were evaluated. It was concluded that the comparative economics showed a modest advantage for the radiation catalysis and the evaluations of material produced to date indicate that there may also be product advantages. (P.C.H.)

31402 RADIATION INDUCED POLYMERIZATION OF VINYL CHLORIDE IN BULK AND EMULSION. Barriac, J.; Oda, E.; Russo, S.; Stahel, E. P.; Stannett, V. (North Carolina State Univ., Raleigh). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 605-11(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A comparison was made between γ-radioinduced bulk and emulsion polymerization of vinyl chloride. At 10% conversion in bulk polymerization the rate was found to be proportional to the square root of the dose rate and to have an activation energy of 512 kcal/mole between −78 and 0°C and close to zero between 0 and 25°C. The molecular weight of the polymer obtained at 30°C was about 100,000. There was little change in molecular weight with conversion up to 89.5% which showed that little or no homografting took place. Typical conversion-time curves for emulsion polymerization were generally linear up to about 70% conversion. With very low soap contents some acceleration was observed from 50% on. The molecular weight of the polymer prepared at 25°C was about 125,000 and appeared to be essentially independent of conversion and soap content type and similar to that prepared in bulk at the same temperature. (P.C.H.)

31403 TECHNICAL DEVELOPMENT OF RADIATION CHEMISTRY IN JAPAN. Danno, Akibumi (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 612-20(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Technical developments in radiation chemistry being carried out in pilot or advanced development stages in Japan are discussed. These include studies on radiation modification of plastics, radioinduced graft polymerization, radioinduced polymerization, and radioinduced synthesis of chemicals. Data on the radiation chemistry studies presently in progress in Japan, including chemical process, location, status, and sources used are tabulated. (P.C.H.)

31404 COMPARISON BETWEEN PHOTOCHEMISTRY AND RADIATION CHEMISTRY. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 801-17(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A comparison was made between photolysis and radiolysis on the following subjects: aqueous solutions; reactions of solvated electron in liquid methanol; and mechanism of scintillation from liquid organic phosphor. A brief discussion on photoionization of organic compounds in solutions is also included. (P.C.H.)

31405 QUESTION IN RADIATION GRAFT POLYMERIZATION. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 818-36(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Problems involved in the development of new plastic synthesis processes, improvement of plastics (balance between properties and cost), wood–plastic combinations, radioinduced and chemically induced graft polymerization, and commercial improvement of properties of textile fibers are discussed. Particular studies concerned with the various problems are considered. (P.C.H.)

31406 RADIATION-INITIATED COPOLYMERIZATION OF VINYL CHLORIDE. PART 1. STYRENE–VINYL CHLORIDE COPOLYMERS. Hummel, D. O.; Ryska, M.; Schneider, Christel (Univ., Cologne). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 996-1001(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Under the influence of γ radiation, styrene and vinyl chloride of normal purity copolymerized at room temperature according to a radical mechanism with r_1 (styrene) ≈ 50. The reaction was very sensitive to temperature and purity of the monomers. High dryness of the monomer mixture favored an ionic process. At −78°C,

the polymerization appeared to be exclusively ionic, yielding almost pure polystyrene ($r_1 \approx 3{,}000$). At room temperature, copolymers over a wide range of compositions were formed. This process was, with highly dried monomers, at least partly ionic, being sensitive to traces of water or triethylamine. Values for r_1 as high as 110 were observed. The microstructure of the copolymers obtained by the partly ionic process deviated from the statistical distribution towards a block-type structure. This was found by field-ion mass spectrometry of the pyrolysis products. Styrene–vinyl chloride copolymers tended to depolymerize primarily within the homo-sequences, yielding mainly benzene and HCl from VC sequences. Styrene–VC links produced a characteristic mass number at 130 (phenyl butadiene). (auth)

31407 RADIATION-INITIATED COPOLYMERIZATION OF VINYL CHLORIDE. PART 2. PROPENE–VINYL CHLORIDE COPOLYMERS. Hummel, D. O.; Denaxas, J.; Schneider, Christel (Univ., Cologne). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 1002-7(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Under the influence of γ radiation, propene and vinyl chloride formed copolymers in a radical process with $r_1 \approx 0.04$, $r_2 \approx 3.5$. The propene units were mainly isolated and acted as "inner plasticizers." Maximum concentration of propene units was about 50%; these copolymers have approximately alternating structure. The overall activation energies were found between 2.4 and 3.5 kcal/mole, depending on the VC concentration. Propene acted as a very effective transfer agent with a MAYO constant of about 2×10^{-3}. (auth)

31408 ELECTRON PARAMAGNETIC RESONANCE INVESTIGATION OF PHOTOCONVERTIBLE RADICALS IN POLYATOMIC ALCOHOLS GAMMA IRRADIATED AT 77°K. Makarov, I. E.; Ershov, B. G. (Inst. of Physical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 3, 530-5(Mar 1970). (In Russian).

The EPR spectra of free radicals in gamma-irradiated polyatomic alcohols at 77°K and in aqueous solutions were studied. The reversible character of the photo- and thermal transformations of these radicals is shown. Photoconversion related to the isomerization of the free radicals was observed. (tr-auth)

31409 INVESTIGATION OF THE MECHANISM OF THE ACTION OF IONIZING RADIATION ON THE ANION EXCHANGER AV-17. Kiseleva, E. D.; Chmutov, K. V.; Kuligina, N. V. (Inst. of Physical Chemistry, Moscow). Zh. Fiz. Khim.; 44: 472-5 (Feb 1970). (In Russian).

The action of γ radiation on specimens of the anion exchanger AV-17 in the NO_3-form was studied. The specimens were irradiated in the dry state (in a vacuum of 1×10^{-4} to 1×10^{-5} mm Hg), in the presence of air oxygen, and with various contents of water. On irradiation in the dry state and in the presence of oxygen at a dose of $0.3 \pm 1 \times 10^9$ rads, the formation of secondary and tertiary amines was observed. This indicates the breakdown of exchangeable groups. On irradiation in water, the yield of trimethylamine passed through a maximum in proportion to the increase of water content. The anion exchanger swelled with water is considered as a new molecule in which a different intramolecular redistribution of energies is possible. (tr-auth)

31410 INVESTIGATION OF THE MECHANISM OF THE ACTION OF RADIATION ON THE CATION EXCHANGER KY-2. Kiseleva, E. D.; Chmutov, K. V.; Kuligina, N. V. (Inst. of Physical Chemistry, Moscow). Zh. Fiz. Khim.; 44: 476-81 (Feb 1970). (In Russian).

The effects of water, air oxygen, and various ions on the breakdown of the ion exchange sulfo groups on the irradiation of KY-2 were studied. The irradiation was conducted on the H^+, Fe^{3+}, Ce^{4+}, and Cu^{2+} forms. With increasing radiation dose from 0.62 to 2.1 rads in the dry state, the breaking away of the ion exchange groups increased and the mass and swelling decreased. The capacity of the ion exchanger decreased most in the H^+ form on irradiation. The yield of sulfuric acid and the capacity loss increased up to a definite water content and then remained constant. (tr-auth)

31411 EFFECT OF ELECTRON BOMBARDMENT ON LUMINESCENCE OF ELECTROLUMINOPHORS. Kolomoitsev, F. I.; Belov, D. G.; Kondrashov, A. P.; Mal'tsev, E. K. Zh. Prikl. Spektrosk.; 12: 145-8(Jan 1970). (In Russian).

The excitation of luminescence of electroluminophors by the action of an electron beam was studied. Separate and combined excitations by electric fields and electron beams were considered. In studies of combined effects, the emergence of negative nonadditivity of the brilliances of luminescence at a fixed value of sinusoidal potential was established. (tr-auth)

31412 INFRARED SPECTRA OF INSOLUBLE PRODUCTS FROM STARCH IRRADIATED WITH GAMMA RADIATION. Zhbankov, R. G.; Komar, V. P.; Korotchenko, K. A. Zh. Prikl. Spektrosk.; 12: 149-50(Jan 1970). (In Russian).

Nitrogenous compounds with peptide groups were identified in products from the gamma radiolysis of starch by ir spectroscopy. (tr-auth)

31413 EFFECTS OF OLEFINS ON THE RADIOLYSIS OF LIQUID CYCLOHEXANE. PART 2. Cramer, W. A.; Piet, G. J. (Interuniversitair Reactor Instituut, Delft, Netherlands). Trans. Faraday Soc.; 66: 850-6(Apr 1970).

Solutions of cyclohexene in cyclohexane have been irradiated with ^{60}Co gamma rays. G-values for C_{12} products were measured. Effects of a number of additives on product yields were investigated. Transfer of reactivity from solvent to solute occurs, giving rise to relatively large yields of $C_{12}H_{18}$. This proceeds by positive charge transfer. Dimeric products were formed by a free radical mechanism. Addition of cyclohexyl radicals to cyclohexene did occur, but a similar reaction of cyclohexenyl radicals was not important. Specific activities were compared for C_{12} products formed by radiolysis and Hg-sensitized photolysis of solutions of ^{14}C-cyclohexene in cyclohexane. Scavenging of homogeneously distributed cyclohexyl radicals by cyclohexene was complete at $[C_6H_{10}] \geq 3 \times 10^{-2}$ M. However, at this concentration and also at $[C_6H_{10}] = 11 \times 10^{-2}$ M the major fraction of dicyclohexyl in the radiolysis was formed in reactions between cyclohexyl radicals. This indicates an inhomogeneous distribution of these radicals in the solution. (auth) (UK)

31414 STUDY OF THE OXIDIZING DEGRADATION OF 1,4-DIOXANE AT 25°C WITH THE RADIOTRACER $^{18}O_2$. Decker, Christian; Marchal, Jean (Centre National de la Recherche Scientifique, Strasbourg). Compt. Rend., Ser. C; 270: 1102-5(23 Mar 1970). (In French).

The use of $^{18}O_2$ and the γ irradiation induction technique made it possible to explain that the auto-oxydegradation of 1,4-dioxane at 25°C is due to monomolecular decomposition of secondary peroxyl radicals according to a mechanism having a hexagonal transition state. (France)

31415 RADIOLYSIS OF ALCOHOLS AT LOW TEMPERATURES. PART 3. SPECTROPHOTOMETRIC INVESTIGATION OF TRAPPED ELECTRONS AND OTHER SPECIES FORMED BY GAMMA-IRRADIATION IN GLASSY METHANOL. Habersbergerova, A.; Josimovic, Lj.; Teply, J. (Nuclear Research Inst., Rez, Czech.). Trans. Faraday Soc.; 66: 656-68(Mar 1970).

The absorption spectrum of electrons trapped in a glassy methanol matrix was investigated and its parameters were determined. The changes of these parameters on optical bleaching and their kinetics were studied; it was found that the broad spectrum is an envelope of partial spectra corresponding to different kinds of trapped electrons and to their various quantum transitions. The parameters of the spectra are influenced by the presence of some solutes. On optical bleaching the electrons are excited to higher levels, from which they collapse to a molecule giving the CH_3O^- ion and simultaneously a hydrogen atom. In accordance with this mechanism the change in the yields of trapped electrons and total hydrogen caused by the presence of electron scavengers correspond. The efficiencies of electron scavengers at 77°K parallel roughly those in liquids at room temperature. The absorption of the irradiated glassy methanol in the uv is evidently due to CH_3OH radicals, as deduced from the kinetics of their disappearance and their reaction with tetranitromethane. (auth) (UK)

31416 RADIOLYSIS OF ALCOHOLS AT LOW TEMPERATURES. PART 4. SPECTROPHOTOMETRIC INVESTIGATION OF TRAPPED ELECTRONS AND OTHER SPECIES FORMED BY GAMMA-IRRADIATION IN GLASSY NORMAL ALCOHOLS C_2–C_4. Habersbergerova, A.; Josimovic, Lj.; Teply, J. (Nuclear Researchinst., Rez, Czech.). Trans. Faraday Soc.; 66: 669-78(Mar 1970).

The absorption spectra of trapped electrons in irradiated glassy normal alcohols from ethanol to hexanol have maxima in a narrow interval of wavenumbers from 1.85×10^6 to 1.73×10^6 m^{-1} but they differ considerably in their width, which increases with increasing length of the alkyl group. The apparent extinction coefficient and oscillator strength decrease linearly with increasing number of carbon atoms in the alcohol. Analysis of the kinetics of photobleaching of trapped electrons, and of the changes of parameters of their absorption spectra caused by light and/or heating, indicates the existence of several kinds of trapped electrons, the composition of which changes during the bleaching process. The total spectrum is an envelope of the partial spectra and it is suggested that it corresponds to excitations of electrons to different levels. In the uv region some weak absorption maxima

belonging to trapped electrons might also exist. A broad absorption over the whole range measured (in n-propanol, n-butanol, and n-pentanol with weak maxima in the uv) corresponds to trapped radicals formed in the radiolysis, together with trapped electrons. (auth) (UK)

31417 KINETICS OF THE OXIDATION OF CERIUM(III) BY PEROXYSULFURIC ACIDS INDUCED BY ^{60}Co γ RADIATION. Matthews, R. W.; Mahlman, H. A.; Sworski, T. J. (Oak Ridge National Lab., Tenn.). J. Phys. Chem.; 74: 2475-9(11 Jun 1970).

$G(Ce^{III})$ decreased with an increase in ammonium persulfate concentration for cerium(IV)–cerium(III) mixtures in air-saturated 4.0M sulfuric acid solutions. At any particular ammonium persulfate concentration, $G(Ce^{III})$ also decreased with increase in age of solution owing to hydrolytic formation of peroxymonosulfuric acid. Oxidation of cerium(III) by peroxysulfuric acids is induced by reaction of H atoms with peroxysulfuric acids to yield the HSO_4 radical, which oxidizes cerium(III). The dependence of $G(Ce^{III})$ on the concentration of peroxysulfuric acids is explicable by a competition between peroxysulfuric acids and oxygen for reaction with H atom. Kinetic analysis yielded $G_H + G_{e_{aq}^-} = 3.38 \pm 0.12$, $k_{H\,H_2S_2O_8}/k_{H_2O_2} = 0.0012 \pm 0.0001$, and $k_{H,H_2SO_5}/k_{H_2O_2} = 0.0106 \pm 0.0006$. (auth)

31418 RADIATION-CHEMICAL CARBONYLATION OF FORMALDEHYDE. Seitner, D.; Getoff, N. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr, Ger. Institut fuer Radiumforschung und Kernphysik, Vienna). Monatsh. Chem.; 100: 1868-80(Nov-Dec 1969). (In German).

In order to study the reactivity of the CHO radical and of its hydrated form, $CH(OH)_2$, in respect to the carbonylation process, the formation of glyoxal as a radiolytic product from 0.01 M formaldehyde in the presence of argon or carbon monoxide was investigated. It was established that irradiation of aqueous carbon monoxide primarily causes the formation of the CHO radical whereas formaldehyde immediately gives rise to its hydrated form. The different glyoxal yields obtained under various experimental conditions (dose, dose rate, concentration of formaldehyde, change of pH) provided evidence, that the CHO radical is the main carbonylating agent. (auth)

31419 PREPARATION OF ^{99m}Tc COATED CARBON PARTICLES FOR MEDICAL USE. El-Garhy, M.; El-Bayoumy, S.; Naguib, M. (Atomic Energy Establishment, Cairo). Isotope Radiat. Res.; 1: 19-24(Oct 1968).

Adsorption of ^{99m}Tc on active carbon particles at different acidities was investigated. Current method for preparing ^{99m}Tc-coated carbon particles is described. The method consists of adsorbing ^{99m}Tc from 0.025N hydrochloric acid solution in the presence of ascorbic acid on active carbon particles, then suspending these particles in a medium. The effect of the suspending medium on desorption of ^{99m}Tc from carbon coated with technetium activity was studied. Desorption decreased from 20 to 2.2% when ascorbic acid was present in the coating step. More than 97% of the injected dose is retained by the lungs. Studies demonstrate the feasibility for performing human lung scans. (auth)

31420 RADIOISOTOPE PRODUCTION AND MATERIALS: THE STATUS OF TECHNOLOGY AND CAPABILITY. Eister, W. K.; Jackson, K. C.; Lindsey, W. J. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 65(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31421 ISOTOPE PRODUCTION FROM POWER REACTORS. Wood, P. M. (Union Carbide Corp., Oak Ridge, Tenn. Atomic Energy Commission, Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc.; 13: 65(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31422 PRODUCTION OF HIGH-PURITY ^{238}Pu FROM IRRADIATION OF ^{237}Np. Christensen, F. B.; Cornman, W. R. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc.; 13: 65(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31423 FUTURE AVAILABILITY OF FISSION PRODUCT CESIUM AND STRONTIUM. Van Tuyl, H. H. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 66-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31424 RECENT TECHNICAL PROGRESS IN THE USAEC'S PROGRAM IN PROCESS RADIATION. Rotariu, George J.; Miller, Lowell A. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 68(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31425 CONCRETE-POLYMER MATERIALS AND POLYMER-CONCRETE COMPOSITES. Steinberg, M.; Manowitz, B.; Kukacka, L. E.; Colombo, P.; Fontana, J.; Farber, G. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 13: 68-9 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31426 RADIATION CROSSLINKING OF POLYMERS WITH SEGREGATED METALLIC PARTICLES. Kusy, R. P.; Malliaris, A.; Turner, D. T. (Drexel Univ., Philadelphia). Trans. Amer. Nucl. Soc.; 13: 69-70(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31427 EVALUATION OF THE APPLICABILITY OF IONIZING RADIATION TO THE TREATMENT OF MUNICIPAL WASTE WATERS AND SEWAGE SLUDGE. Compton, D. M. J. (Enviro-Med Inc., La Jolla, Calif.); Whittemore, W. L.; Black, Sandra J. Trans. Amer. Nucl. Soc.; 13: 71-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31428 RADIOLYSIS OF MALACHITE GREEN DYE SOLUTIONS. Johnson, John E. Jr.; Wacks, Morton E. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 13: 72-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31429 GAS TO CONDENSED PHASE TRANSITION IN HOT ATOM CHEMISTRY. Richardson, A. E.; Wolfgang, Richard (Univ. of Colorado, Boulder). J. Amer. Chem. Soc.; 92: 3480-2(3 Jun 1970).

Absolute yields of ^{18}F-labeled products from recoil reactions of ^{18}F with fluoromethane were measured for densities from 0.0014 to 1.1 g/cm^3. Hot ^{18}F was produced by the $^{19}F(n,2n)^{18}F$ process in ampoules. The requisite fast neutrons resulted from 26-MeV protons reacting with heavy water. Yields of two substitution products were plotted against density and estimates of the corresponding mean intermolecular distance. (M.C.G.)

31430 RADIATION-INDUCED DEGRADATION OF CELLULOSE AND A FEW RELATED COMPOUNDS. Ahmed, A. U.; Rapson, W. H. (Univ. of Toronto). Nucl. Sci. Appl., Ser. A; 5: 33-9(Apr 1969).

The degradation of cellulose due to gamma irradiation was studied by viscometry. Charlesby's theory of radioinduced degradation of cellulose is discussed. The slopes of lines log (η) against log ($R + R_0$) for cotton linters, wood pulp, and rayon, which have different degrees of crystallinity, were different and could not be used to calculate $\overline{M}_v$ accurately. Using osmometry to find the number average molecular weight of cellulose triacetate, it was shown that the G value for chain cleavage does not remain constant but decreases rapidly during the initial stages of irradiation. A much more drastic decrease (about 20 fold) in the G (-glucose) was estimated to take place during irradiation of crystalline glucose using data from the literature. (auth)

31431 POSITRON LIFETIME MEASUREMENTS IN POLYPROPYLENE IRRADIATED IN DIFFERENT MEDIA. Khan, M. N. G. A. (Atomic Energy Centre, Decca, Pakistan). Nucl. Sci. Appl., Ser. A; 5: 40-2(Apr 1969).

A comparison of positron lifetime data with some relevant radiation chemical data in ^{60}Co gamma-irradiated isotactic polypropylene is reported. The difficulty of observing radioinduced crosslinking in the polymer by a corresponding increase in the ortho-positronium lifetime, τ_2, is pointed out. Decrease in the corresponding intensity, I_2, in irradiated polymer is attributed to positron capture at the scission sites. A preliminary correlation between the positron capture probability and scission fraction is presented. (auth)

31432 RADIATION CHEMICAL APPROACH TO RADIOBIOLOGY. Adams, G. E. (Mount Vernon Hospital, Northwood, Eng.). pp 187-98 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

The redox nature of radioinduced free radical processes in both

biological and nonbiological material is reviewed. In particular, the roles played by thermal electrons, stabilized either by solvation or by interaction with electron traps in macromolecules, is discussed. Examples of free radical repair by sulfydryl compounds were observed directly by pulse radiolysis techniques and the effect of oxygen on these processes shows that the oxygen/SH competition model, often employed in radiobiology, does occur in simple model systems. Pulse radiolysis studies on sulfur-containing enzymes provided evidence of electron migration followed by localization on disulfide bridges in such molecules. Similarly, the results of radiation chemical studies on bromouracil and thymine mixtures suggest a molecular mechanism for the BUdR effect in which electron migration is again involved. Some preliminary rapid mixing experiments in bacteriological systems are described in which the time scales of the dose modification effects of oxygen and other sensitizers were measured. (auth)

31433 EPR STUDIES ON TRAPPED SPECIES PRODUCED BY TRITIUM β PARTICLES IN ALKALINE AND ACID ICES AT 77°K. Hase, Hirotomo; Kevan, Larry (Univ. of Kansas, Lawrence. Wayne State Univ., Detroit). J. Chem. Phys.; 52: 3183-8(15 Mar 1970).

EPR studies were performed on ^{60}Co γ-irradiated 6M and 10M NaOH and 11M H_2SO_4 frozen solutions at 77°K and on similar frozen solutions tritiated with T_2O. The yield of trapped species was always larger in the γ-irradiated systems than the corresponding yield in β-irradiated systems. The γ/β yield ratios were in semiquantitative agreement with similar ratios in liquid solutions. This is discussed in terms of different mean linear energy transfer for tritium β and ^{60}Co γ radiation. Paramagnetic relaxation studies versus radiation dose were carried out on the tritiated systems and compared with previous results on γ-irradiated systems. For trapped H atoms in acid ice a spatially uniform distribution was found for both β and γ radiolysis. Trapped electrons in alkaline ice show a nonuniform distribution for γ radiolysis characterized by a finite spur radius. The distribution is also nonuniform in β radiolysis, but the average spur radius is larger. Surprisingly, the local concentration of trapped electrons appears smaller in β compared to γ radiolysis. A greater fraction of overlapping spurs in β radiolysis can account for these results. (auth)

31434 PULSE RADIOLYSIS STUDIES. XVI. KINETICS OF THE REACTION OF GASEOUS HYDROGEN ATOMS WITH MOLECULAR OXYGEN BY FAST LYMAN-α ABSORPTION SPECTROPHOTOMETRY. Bishop, W. P.; Dorfman, Leon M. (Ohio State Univ., Columbus). J. Chem. Phys.; 52: 3210-16(15 Mar 1970).

The pulse radiolysis method was used to produce ground-state hydrogen atoms in gaseous hydrogen and was combined with fast Lyman-α absorption spectrophotometry to observe these atoms directly with microsecond time resolution. The technique was used to study the kinetics of the reaction $H + O_2 + M = HO_2 + M$, where M is H_2. The rate constant for this reaction was found to have the value $(1.7 \pm 0.4) \times 10^{10} M^{-2} \cdot sec^{-1}$ at 298°K. This value, together with earlier data for Ar as third body, gives $k^{H_2}/k^{Ar} = 2.0$ at 298°K for the ratio of the efficiencies of H_2 and Ar as third body in this reaction. (auth)

31435 APPEARANCE ENERGY AND ENERGY DEPENDENCE OF THE RECOIL PRODUCT YIELD IN INDIUM ETHYLENEDIAMINETETRA-ACETATE BY THE $^{115}In(\gamma,\gamma')^{115m}In$ REACTION. Yoshihara, K.; Kudo, H. (Japan Atomic Energy Research Inst., Tokai). J. Chem. Phys.; 52: 2950-3(15 Mar 1970).

The concept of the "appearance energy" was proposed by observing the recoil product yield as a function of recoil energy in a solid system. The yield of $^{115m}In^{3+}$ ion following the $^{115}In(\gamma,\gamma')^{115m}In$ reaction in indium ethylenediaminetetraacetate (In-EDTA) was zero in the low-recoil-energy region and it increased from a threshold value of recoil energy, that was named the "appearance energy," to a saturation yield in the higher energy region. The appearance energy of the $^{115m}In^{3+}$ ion in In-EDTA was about 60 eV with possible errors of factor 2. The meaning of the appearance energy is discussed in comparison with the displacement energy in solid-state physics. From the energy dependence curve it was suggested that the reaction of the recoil atom might be divided into three categories corresponding to the three parts of the recoil range. (auth)

Radiochemistry

Refer also to aostracts 31249, 31270, and 31351.

31436 CHEMICAL EFFECTS OF DECAY OF INCORPORATED RADIOISOTOPES. Kacena, V. (Inst. of Nuclear Research, Rez, Czech.). pp 199-214 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

The role of various factors and their importance for the chemical behavior of daughter species formed in beta decay, electron capture, and isomeric transitions are discussed and some specific features of these processes demonstrated. (auth)

Separation Processes

Refer also to abstracts 31234, 31235, 31240, 31262, 31320, 31340, 31341, 31345, 31423, 31545, 31560, 31574, 31648, 31650, 31664, 31671, 31984, and 32357.

31437 (ANL-7473) ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 14. PROCESSING EXPERIENCE IN FLUORINATING PLUTONIUM MATERIALS AND THERMALLY DECOMPOSING PLUTONIUM HEXAFLUORIDE IN THE ENGINEERING-SCALE ALPHA FACILITY. Levitz, N. M.; Vogel, G. J.; Carls, E. L.; (and others) (Argonne National Lab., Ill.). Nov 1969. Contract W-31-109-eng-38. 119p. Dep. CFSTI.

The applicability of fluoride-volatility methods to the reprocessing of light-water-reactor fuels was demonstrated in a program of fluid-bed fluorination studies and fluid-bed thermal-decomposition studies conducted in an engineering-scale alpha facility. Studies were conducted on nonirradiated UO_2-PuO_2-F.P. pellet materials and PuF_4 powder charges. Key features of this work were the production and transport of PuF_6, and the demonstration of good plutonium material balances. The results of these studies are considered applicable to processes for high-plutonium materials, such as fast-breeder-reactor fuels and plutonium scrap materials. (auth)

31438 (DOCKET-50332-12) BARNWELL NUCLEAR FUEL PLANT. Addendum No. 5 to Safety Analysis Report. (Allied-Gulf Nuclear Services, Florham Park, N. J.). 9 Jun 1970. 11p. Dep. CFSTI.

Information submitted on safety analysis includes: use of cooling pond for high-level waste cooling and high-level liquid waste storage. (M.C.G.)

31439 (EUR-4419) EUREX EURATOM-CNEN AGREEMENT. Annual Report, 1968. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 24 Jul 1969. 58p. (In Italian). Dep. CFSTI (U. S. Sales Only).

The fourth year of activity of the Eurex project since the signature of the Convention CEEA-CNEN No. 001-64-11 RCII for the construction, exploitation, and utilization of the Eurex plant for industrial research is described. (auth)

31440 (IN-1285) CHEMICAL DEVELOPMENT FOR EBR-II FUEL PROCESS, 1967-1969. Musgrave, B. C.; Butzman, R. G.; Evans, T. L.; Jacobson, M. E.; Lewis, L. C.; Wilding, M. W.; Zimmerman, C. A. (Idaho Nuclear Corp., Idaho Falls). Apr 1970. Contract AT(10-1)-1230. 35p. Dep. CFSTI.

The laboratory development work done at Idaho Chemical Processing Plant for the electrolytic dissolution process for EBR-II fuels is summarized. Topics reported include fuel storage, dissolution, characterization of the solid residues resulting from electrolytic dissolution, solvent extraction of uranium from the dissolver product solutions, and corrosion of materials of construction. (auth)

31441 (IN-1375) SIMULATION OF THE ELECTROLYTIC DISSOLVER PLANT FOR NUCLEAR SAFETY REVIEW. Brown, Russell A. (Idaho Nuclear Corp., Idaho Falls). Jun 1970. Contract AT(10-1)-1230. 23p. Dep. CFSTI.

The behavior of the electrolytic dissolver plant was simulated on an analog computer. Uranium concentration-time profiles were computed for the complete range of possible operating conditions and uranium dissolution rates. The calculated concentration maxima were used to define generalized safe operating conditions for the plant start-up. The generalized limits, 0.23 U_L for number of elements charged, 2800/Ie for charging frequency, and Ie/8 for fresh acid feed rate, will be combined with criticality calculations to specify the exact conditions for safe operation. (auth)

31442 (IS-T-370) SEPARATION OF THE HEAVIER RARE EARTHS BY FRACTIONAL SOLVENT EXTRACTION. Thomas, Norman Earl (Ames Lab., Iowa). Feb 1970. Contract W-7405-eng-82. 63p. Dep. CFSTI.

Thesis.

Equilibrium data were obtained for the systems $TmCl_3$–5M HCl–H_2O–1M D2EHPA (in Amsco Odorless Mineaarl Spirits) and $YbCl_3$–$TmCl_3$–5M HCl–H_2O–1M D2EHPA–Amsco. The separation factor for $YbCl_3$ with respect to $TmCl_3$ was found to be essentially constant with an arithmetic average value of 3.22. An empirical correlation was developed for predicting the total distribution coefficients for the binary lanthanide system $YbCl_3$–$TmCl_3$–5M HCl–H_2O–1M D2EHPA–Amsco. A digital computer program was written, using the experimental distribution function and the experimental value of the separation factor, to predict the operating conditions necessary for the fractional extraction of a 90% $YbCl_3$–10% $TmCl_3$–5M HCl feed into a 98% $YbCl_3$ extract product at 90% $YbCl_3$ recovery. A comparison of the results predicted by the computer technique and the results obtained experimentally by a laboratory simulation of the extraction process indicated that the technique was valid. (auth)

31443 (LA–4391) A ^{13}C PRODUCTION PLANT USING CARBON MONOXIDE DISTILLATION. Armstrong, Dale E.; Briesmeister, Arthur C.; McInteer, B. B.; Potter, Robert M. (Los Alamos Scientific Lab., N. Mex.). 18 Feb 1970. Contract W-7405-eng-36. 27p. Dep. CFSTI.

A fractional distillation plant using carbon monoxide with an isotope separation capacity of approximately one mole per day of ^{13}C at 95% concentration was built, and operated for eight months. The distillation column is 140 ft long, has a single 1-in.-diam column for the bottom 80 ft, 20 ft of four 1-in. columns in parallel in the middle, and a top section of 40 ft of 12 columns in parallel. It is packed with wire helices. The column is fed at the 120-ft level; in the top 20 ft, 135 moles of CO per day are stripped to 0.5% ^{13}C from the natural abundance of 1.1%. The HETP is about 1 in. The column is enclosed in a 6-in.-diam Dural vacuum jacket, using Styrofoam spacers and aluminized Mylar film insulation, and is situated in a 125-ft-deep hole in the ground that has an 18-in.-diam steel liner extending 15 ft above ground into a second-story control room. The plant uses about 1 kW of heat, and about 1000 liters per day of liquid nitrogen, of which about half is used to condense the carbon monoxide. (auth)

31444 (ORNL–4436) AQUEOUS PROCESSING OF LMFBR FUELS: TECHNICAL ASSESSMENT AND EXPERIMENTAL PROGRAM DEFINITION. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 414p. Dep. CFSTI.

The development program initiated for the resolution of problems posed by the processing of spent fuels from Liquid Metal Fast Breeder Reactors is described. These fuels cannot be transported and processed by methods currently employed for light water reactor fuels owing to the high decay heat evolution and to the high plutonium content, which alters chemical requirements and necessitates considerations of criticality. (auth)

31445 (ORNL–TM–3004) THORIUM FUEL CYCLE DEVELOPMENT PROGRESS REPORT NO. 8, MARCH 1970. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 24p. Dep. CFSTI.

Topics covered include: head-end reprocessing development, refabrication development, materials irradiation, and uranium-233 reprocessing. (M.C.G.)

31446 (ORNL–TM–3032) THORIUM FUEL CYCLE DEVELOPMENT PROGRESS REPORT NO. 10. (Oak Ridge National Lab., Tenn.). May 1970. Contract W-7405-eng-26. 22p. Dep. CFSTI.

Topics covered include: head-end reprocessing development, refabrication development, materials irradiation, ^{233}U reprocessing. (M.C.G.)

31447 (UCRL–50847) RECOVERY OF THE ACTINIDE–RARE-EARTH FRACTION FROM HUTCH SAMPLES. Quong, R.; Cowles, J. O. (California Univ., Livermore. Lawrence Radiation Lab.). 7 Apr 1970. 10p. Dep. CFSTI.

Hutch is the most recent and most successful test of a device designed to produce large quantities of transcurium isotopes. To obtain the isotopes, samples of shot-melted rock (debris) are recovered by drilling back into the shot region. The melt is then processed to isolate and recover the actinide–lanthanide fraction. The existing debris processing facility was modified for Hutch to semicontinuous batch processing. The facility was prepared to process up to 500 kg of Hutch material. From all the material recovered, only 10 kg of high-quality debris was separated. A transcurium–rare earth fraction was isolated from this 10 kg. The chemical yield was 76%. The transcurium–rare earth product was further processed by the Heavy Elements Group, Lawrence Radiation Laboratory Radiochemistry Division to isolate individual elements and to assay individual isotopes. Possible modifications to future processing operations, suggested by Hutch experience, are presented. (auth)

31448 (UJV–2361–CH) STUDIES OF KINETICS OF STRONTIUM SORPTION USING METASTABLE BARIUM–CALCIUM SULFATE. Vojtech, O. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1970. 23p. (In Czech). Dep. CFSTI (U. S. Sales Only).

Studies were made of strontium sorption kinetics, using barium and calcium sulfates after a special thermal treatment as sorbents. A proposed model equation for kinetic evaluation was used and relevant constants calculated. The correlation of measured constants with appropriate specific surface measurements led to important conclusions concerning the effect of various thermal treatment on structural properties of sorbents and their sorption abilities. These results were in full agreement with calcium ion dissolution rate results. (auth)

31449 SEPARATION OF ^{99m}Tc FROM ^{99}Mo BY SOLVENT EXTRACTION WITH ISOBUTYL METHYL KETONE. Baishya, N. K.; Heslop, R. B.; Ramsey, A. C. (Univ. of Manchester, Eng.). Radiochem. Radioanal. Lett.; 4: 15-20(10 May 1970).

Isobutyl methyl ketone (4-methyl-2-pentanone) extracts ^{99m}Tc from the decay products of ^{99}Mo-labelled molybdate, without the use of complexing agents, in the pH range 0.5 to 13.0, whereas from 6M HCl it extracts an equilibrium mixture of ^{99}Mo–^{99m}Tc. (auth)

31450 RAPID SOLVENT EXTRACTION METHOD FOR THE DETERMINATION OF ^{137}Cs IN ENVIRONMENTAL MATERIALS. Flynn, W. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Anal. Chim. Acta; 50: 365-73 (Jun 1970).

A solvent extraction method for the quantitative determination of ^{137}Cs in environmental samples is described. Cesium carrier is added to the ashed sample, which is dissolved with HCl. The solution is filtered to remove any C and the pH is adjusted to 3.0 ± 0.5. Sodium dodecylbenzene sulfonate is added and the extraction is done with phenol–nitrobenzene mixture. The organic phase is washed with EDTA solution, and the Cs is stripped from the washed solvent with 6M HCl. The Cs is precipitated as cesium chlorostannate to ensure absolute decontamination from ^{40}K. Recovery from standard solution is about 85% and from vegetation, rainwater, and effluent samples about 80%. The method is applicable in the presence of large quantities of interfering ions, and decontamination factors for many nuclides are greater than 10^5. (auth)

31451 COLUMN REVERSED-PHASE PARTITION CHROMATOGRAPHY FOR THE ISOLATION OF SOME RADIONUCLIDES FROM BIOLOGICAL MATERIALS. Testa, Corrado (CNEN-CSN, Casaccia, Italy). Anal. Chim. Acta; 50: 447-55(Jun 1970).

Reversed-phase partition chromatography is a very useful tool for selective isolation of radionuclides from biological materials. Some new applications of this technique to the resolution of practical problems in radiation protection are reported. Natural Th and enriched U can be determined separately and together in urine by means of a column of Microthene-710 supporting a solution of tri-n-octylphosphine oxide (TOPO) in cyclohexane; batchwise extraction processes with Microthene supporting TOPO are also successful. Strontium-90 is determined in urine by a batch extraction of ^{90}Y with a slurry of Microthene supporting the liquid cation exchanger di-(2-ethylhexyl)phosphoric acid. Only a wet mineralization of the urines is required and the analyses are simple, rapid, and sufficiently accurate. A method for the isolation of iodine from foodstuffs with a Microthene–benzene column is also described. (auth)

31452 PRINCIPAL RULES FOR URANIUM EXTRACTION BY PHOSPHINE OXIDES. Laskorin, B. N.; Skorovarov, D. I.; Fedorova, L. A.; Shatalov, V. V. At. Energ. (USSR); 28: 383-8 (May 1970). (In Russian).

The dependence of extraction of uranium from HNO_3, HCl, and H_2SO_4 solutions by mono-, di-, and polyphosphine oxides of different structure was investigated. The largest coefficients of distribution were observed among tri(alkyl)phosphine oxides when the length of chain was C_8–C_{10}. Tri(aryl)phosphine oxides were found to have very poor extraction properties. These properties for mixed derivatives increased from tri(aryl) → diarylalkyl → aryldialkyl. Tri(cyclohexyl)phosphine oxide has the best extraction properties. The main regularities of extraction were investigated on tri(octyl)phosphine oxides; complexes generated with uranium sulfate were defined. To define characteristics of extraction properties of phosphine oxides interdependence between physical properties (Vp = 0) and distribution coefficient of uranium was investigated. The influence of length alkylene bridge between phosphorus atoms on uranium extraction was investigated for bidentate phosphine oxides. It was shown that compounds with ethylene bridge have the largest extraction properties. (auth)

31453 PREPARATION OF RI SOURCES BY THE IPCR CYCLOTRON FOR THE STUDY OF SOLID STATE PHYSICS. Ambe, S.; Shiotani, N.; Okada, T.; Karasawa, T.; Saito, N. (Inst. of Physical and Chemical Research, Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 50-2(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Radiochemical separations for the preparation of radioisotope sources of high radiochemical purity for use in solid state physics are described for ^{57}Ni and ^{55}Co positron sources and a ^{57}Co Moessbauer source. (P.C.H.)

31454 SEPARATION OF RADIOACTIVE ELEMENTS BY THE ELECTROLYTIC CHROMATOGRAPHY. Fujinaga, T.; Koyama, M.; Izutsu, K.; Okazaki, T.; Tsuji, K. (Kyoto Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 83-7(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Electrolytic chromatography with a glassy carbon column electrode was used for the separation of ^{212}Pb, ^{212}Bi, and ^{208}Tl even in extremely dilute solutions. The method was found to be applicable to tracer amounts up to ordinary amounts. (P.C.H.)

31455 STATE OF Pa(V) IN A PERCHLORIC ACID SOLUTION. Suzuki, Shin; Inoue, Yasushi (Tohoku Univ., Sendai). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 88-91(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The solvent extraction of Pa(V) from perchloric acid solutions by benzene–TTA was used to study the aqueous chemistry of ^{23}Pa(V). The addition of 2,6-dimethyl-4-heptanol exhibited a synergistic effect and thus enhanced the extraction of Pa. The reactions involved in the mechanism of the extraction are given. (P.C.H.)

31456 RADIOACTIVE WASTE (SEA WATER) TREATMENT BY COAGULATION METHODS. Ijuin, M.; Tanaka, G. (National Inst. of Radiological Sciences, Chiba, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 161-2(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Two coagulation methods are described for reactor fuel reprocessing waste that was dissolved in seawater. The efficiency of the removal is discussed. Strontium was precipitated as phosphate by adding phosphoric acid and sodium hydroxide; Cs and rare earth metals (such as Ce) were removed by coagulation of cupric ferrocyanide. The efficiency of removal is discussed. It was concluded that the coagulation methods may be very useful for the treatment of contaminated seawater. (P.C.H.)

31457 RECOVERY OF USEFUL RADIOISOTOPES FROM SPENT FUELS AND THEIR APPLICATION. Ishihara, Takehiko (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 549-51(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Developments in the reprocessing of spent fuels for the recovery of fission products and transuranium elements produced by neutron absorption are discussed. The economics and uses of radioisotopes recovered from spent fuels are also discussed. (P.C.H.)

31458 1-[(5-CHLORO-2-PYRIDYL)AZO]-2-NAPHTHOL AS A NEW EXTRACTION–PHOTOMETRIC REAGENT FOR METALS. Shibata, Shozo; Furukawa, Masamichi; Kamata, Eijiro; Goto, Kazuo (Government Industrial Research Inst., Nagoya, Japan). Anal. Chim. Acta; 50: 439-46(Jun 1970).

The heterocyclic azo compound, 1-[(5-chloro-2-pyridyl)azo]-2-naphthol (5-Cl-β-PAN), forms various colored metal chelates, which can be extracted with different organic solvents. Chelate stability is greatly affected by pH. The molar absorptivities are usually considerably greater than those of the β-PAN chelate. Although the bathochromic shifts produced on chelation are no greater than those with 5-Br-β-PAN, the selectivity is increased. The reactivity of tri- and tetravalent metal ions is decreased appreciably by introduction of the chlorine. A correct choice of pH, solvent, and masking reagent allows 5-Cl-β-PAN to be made reasonably selective. (auth)

31459 RECOVERY OF MOLYBDENUM, VANADIUM, AND URANIUM FROM SOLUTIONS OF CORRESPONDING SALTS. Fitzhugh, Edward F. Jr.; Seidel, Don C. (to Republic Steel Corp.). U. S. Patent 3,510,273. 5 May 1970. Filed 6 Apr 1967.

Molybdenum, vanadium, and/or uranium are separated from their sulfate, nitrate, or chloride solutions by adding metallic iron to the solutions at pH 5 or less, and maintaining the solution temperature at 100°C, or above, until the metal oxides or hydroxides precipitate. (B.L.M.)

31460 CHEMICAL PRINCIPLES OF NUCLEAR FUEL PROCESSING. Knoch, Werner (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH, Leopoldshafen, Ger.). pp 44-54 of Der Nukleare Brennstoffkreislauf. Essen; Vulkan-Verlag Dr. W. Classen (1969). (In German).

From Meeting of House of Technology, Essen, Germany. See CONF-690338.

The principles of the reprocessing of irradiated nuclear fuels for the separation of uranium, plutonium, and fission products are reviewed. Principles of aqueous and high-temperature methods are reviewed. (J.S.R.)

31461 POSSIBILITY OF UTILIZATION OF GLYCINE COMPLEXES FOR THE SEPARATION OF NEODYMIUM–PRASEODYMIUM MIXTURES ON CATION EXCHANGERS. El'khilyali, A. E.; Martynenko, L. I.; Spitsyn, Vikt. I. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 3, 517-21(Mar 1970). (In Russian).

The elution of rare earth elements from cation exchangers by solutions of glycine at various pH values and differing concentrations was not achieved, since glycine complexes that could not be desorbed were formed with rare earths in the resin phase. In frontal analysis, exchange between complexes in solution and the resin did not proceed because of an unfavorable kinetic factor; therefore, the separation of mixtures of rare earths was close to zero. (tr-auth)

31462 EXTRACTION OF LANTHANIDES WITH A MIXTURE OF THENOYLTRIFLUOROACETONE WITH TRI-N-OCTYLAMINE. Genov, L.; Georgiev, G. (Chemisch-Technologische Instituts, Sofia). Monatsh. Chem.; 100: 1892-1900(Nov-Dec 1969). (In German).

The extraction of praseodymium, gadolinium, and ytterbium with a mixture of thenoyltrifluoracetone (TTA) and tri-n-octylamine (TOA) in CCl_4 was investigated. It was found that extractionable compounds of the type $GdT_3 \cdot TOA$, $GdT_3 \cdot TOA \cdot HT$, and $YbT_3 \cdot TOA \cdot HNO_3$, $YbT_3 \cdot TOA$, as well as $YbT_3 \cdot TOA \cdot HT$ are formed in the case of gadolinium and ytterbium, leading to an increase of the distribution coefficients. No similar increase is observed with praseodymium. It is assumed that the amine and amine products are bound directly to the atom of the metal (complex-builder). (auth)

31463 SEPARATION OF PROTACTINIUM(V) FROM SILICON AND OTHER ELEMENTS BY EXTRACTION FROM HYDROFLUORIC ACIDS SOLUTIONS. Palshin, E. S.; Davydov, A. V.; Ivanova, L. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 25: 924-9(May 1970). (In Russian).

A study was made of the extraction of protactinium, silicon, niobium, tantalum, iron(III), manganese(II), zirconium, and other elements with trioctylamine in xylene and in chloroform from hydrochloric acid solutions. The distribution of H_2F_2 between a 0.23M solution of trioctylamine in chloroform and the aqueous phase was examined. The extraction from H_2F_2 solutions with an amine solution in xylene followed by washing the extract with solutions of suitable complex forming substances can be used for separating protactinium from silicon, niobium, tantalum, and other elements. The method can be also used for separating many other elements from silicon. (auth)

31464 OUTBREAKS OF LEUKEMIA IN JAPAN. Kobayashi, Hiroshi; Kamibayashi, Koji (Hokkaido Univ., Sapporo). Nippon Ketsueki Gakkai Zasshi; 43: 810-17(Oct 1968). (In Japanese).

Etiologic factors in leukemia, including ionizing radiation, were considered in relation to outbreaks of leukemia in Japan. An extremely high incidence of leukemia in certain areas and during certain periods was reported in the towns of Shirakawa and Shizunai. In an examination of the details of outbreaks of leukemia deaths in all cities and towns of Japan, the number of leukemia deaths was calculated in 3288 cities and towns for the 5 years from 1962 to 1966. To study the spatial distribution, all the towns were stratified into several population groups. In each group the observed distribution of number of towns with reference to the number of leukemia deaths was compared with that of the expected distribution (Poisson distribution). As a result, the observed frequency of towns that had a number of leukemia deaths in the 0 to 5 group was definitely higher than that of the expected frequency, at the 5% significance level. When the temporal clustering of leukemia deaths in all cities and towns in Japan was investigated by the method described by Ederer, a 1-yr cluster was noted at the 5% significance level in all Japan and at the 1% significance level in the Kyushu area. These results suggested

that the spatial and temporal distribution of leukemia deaths in Japan does not occur at random, and it may, therefore, be influenced by certain factors related to the cause of leukemia. New outbreaks of leukemia (less than 0.5% Poisson distribution at 1% significance level) occurred in 5 towns: Ryozen (Fukushima prefecture), Kabe (Hiroshima prefecture), Yamato (Saga prefecture), and Saishi and Kunimi (Nagasaki prefecture). The prevalence of rubella was noted one year before the outbreak of leukemia in Shizunai, and 2 out of the 5 cases in Kabe were victims of the atomic bomb in Hiroshima. No other causal factors yet have been detected. Etiological aspects were discussed from the viewpoints of pathology, virology, immunology, and epidemiology, and with special reference to the importance of some viral agents in leukemogenesis. (BBB)

31465 EQUILIBRIUM DISTRIBUTION OF YTTRIUM IONS BETWEEN 0.5M AQUEOUS SODIUM PERCHLORATE AND VARIOUS UNTREATED AND ANION DIAZOMETHANE TREATED CATION AND ANION EXCHANGERS. Ismail, M.; Lyle, S. J. (Univ. of Kent, Canterbury, Eng.). Nucl. Sci. Appl., Ser. A; 5: 50-2(Apr 1969).

The effect of pH on the distribution coefficient of Y^{3+} ion between 0.5M aqueous sodium perchlorate and the following ion exchange resins was studied: cation exchangers (a) Zeo-karb-225 (b) Bio-Rad AG-50W-X_4; and anion exchanger, De-Acidite FF. The possibility of these resins being contaminated with stray weak acidic groups (of the carboxylic type) was also investigated in the course of this work. Only De-Acidite FF showed some contamination of this type. (auth)

31466 DYNAMIC PROGRAMMING FOR EXPANSION PLANNING OF THE FUEL REPROCESSING INDUSTRY. Larson, R. E. (Systems Control, Inc., Palo Alto, Calif.); Rees, F. J.; Nichols, J. P. Trans. Amer. Nucl. Soc.; 13: 38-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31467 SIGNIFICANT PROPERTIES OF CHEMICAL REPROCESSING PLANT ACCOUNTABILITY DATA. Christensen, D. E.; Matsen, R. P.; Schneider, R. A. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 48-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31468 COPRECIPITATION OF TRACE LEVELS OF PROTACTINIUM ON LaF_3. Knab, Daryl; Wessman, R. A. (Trapelo/West, Richmond, Calif.). Trans. Amer. Nucl. Soc.; 13: 73(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31469 COLUMN SEPARATION BY ISOTOPIC EXCHANGE IN AN ORGANIC MEDIUM. Tang, Chung-wai; Maletskos, Constantine J. (New England Deaconess Hospital, Cambridge, Mass.). Trans. Amer. Nucl. Soc.; 13: 73-4(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31470 AQUEOUS REMOVAL OF SODIUM BOND FROM UNIRRADIATED HALLAM FUEL ELEMENTS. Miller, G. P. (National Lead Co. of Ohio, Cincinnati). Trans. Amer. Nucl. Soc.; 13: 163-4(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31471 COMPARISONS OF EXPERIMENT WITH CALCULATIONS FOR STRONGLY ABSORBING ROD LATTICES. Fox, J. K. (Idaho Nuclear Corp., Idaho Falls). Trans. Amer. Nucl. Soc.; 13: 383(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 31286, 31364, 31754, and 31984.

31472 (BNWL-1392) RADIOLOGICAL STATUS OF THE GROUND WATER BENEATH THE HANFORD PROJECT, JULY-DECEMBER 1969. Denham, D. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT(45-1)-1830. 20p. Dep. CFSTI.

Data collected during July through Dec. 1969 on the ground water contamination that resulted from disposal of plant wastes at Hanford, Washington are presented and evaluated. (L.C.L.)

31473 DECAY PRODUCTS OF URANIUM AND THORIUM IN ACTIVE VOLCANISM IN THE USSR. Kuptsov, V. M.; Cherdyntsev, V. V. (Geological Inst., Moscow). Geochem. Int. (Engl. Transl.); 6: 532-45(1969).

Translated from Geokhimiya; No. 6, 643-58(Jun 1969).

Contents and ratios of isotopes: ^{238}U, ^{234}U, ^{232}Th, Io, RdTh (^{228}Th), ^{227}Ac, ^{226}Ra, MsTh (^{228}Ra), RaD (^{210}Pb) have been investigated in 70 specimens of water (vapor condensates and fumarole waters) and fumarole minerals of the same volcanoes from the Kamchatka and Kuril Islands. The radioactivity of vapor condensates are given. The contents of the isotopes decrease as follows: $^{234}U > ^{238}U >$ Io $> ^{232}Th > ^{231}Pa$ (the primordial and long-lived isotopes) and: Rn > MsTh > ^{226}Pa > Pb(?) > ^{227}Ac (the isotopes collected as recoil atoms). The value of isotope contents and their ratios vary widely but the average values are rather constant. (auth)

31474 EVALUATION OF THE AGES OF URANIUM-BEARING HYDROMORPHIC SOILS FROM THE ACCUMULATION OF ^{230}Th. Andreev, A. G.; Komarov, V. S.; Lopatkina, A. P.; Sergeev, A. N. Geochem. Int. (Engl. Transl.); 6: 580-4(1969).

Translated from Geokhimiya; No. 6, 724-8(Jun 1969).

Hydromorphic soils of high uranium content may be dated by the $U/^{230}Th$ method if: the age of the uranium accumulation is the same as that of soil formation; allowance can be made for the ^{230}Th content of the soil-forming water; and there is no migration of U or Th beyond the accumulation area. The ages of shallow hydromorphic soils in three areas in East Siberia are between 1600 and 2800 years, in agreement with carbon-14 ages. (auth)

31475 EFFECT OF AMERICAN BEECH TREES ON THE GAMMA RADIOACTIVITY OF SOILS. Gersper, P. L. (Ohio State Univ., Columbus). Contract AT(11-1)-414. Soil Sci. Soc. Amer., Proc.; 34: 318-23(Mar-Apr 1970). (COO-414-7).

Various factors that affect the distribution of gamma-emitting radioisotopes in soils under mature American beech trees (Fagus grandifolia L.) were investigated. Because of its smooth bark and consequent greater amounts of stemflow this species concentrates more fallout radioisotopes in soil near its stem than most other species. Soil near the stems of beech trees contained considerably more fallout and was subjected to greater leaching of natural radioisotopes, to a depth of 30 cm or more, than soil not affected by stemflow water. Depth penetration of fallout and leaching of natural radioisotopes was greater in Dekalb fine sandy loam than in Bennington silt loam. Radioisotope distribution in soil under these trees was also affected by variations of stemflow around the stems, slope gradient, and the quantity and distribution of organic litter on the forest floor. Near two trees that had variable stemflow, the surface soil contained an average of five times more fallout on the high-stemflow sides of the stems than on the low-stemflow sides. Under a beech tree growing on a 20% slope, soil on the downslope side of the stem contained more fallout than soil on the upslope side. Organic litter had a much higher content of fallout than of naturally occurring radioisotopes. As a consequence of the greater concentrations of fallout, herbaceous plants, spicebush (Lindera benzoin L.), and American beech saplings growing near the stems of mature beech trees had higher uptakes of these radioisotopes than those growing farther from the stems. (auth)

31476 TRACER AIDS INTERPRETATION OF PUMPING TEST. de Laguna, Wallace (Oak Ridge National Lab., Tenn.). Water Resour. Res.; 6: 172-84(Feb 1970).

The nuclear research center at Mol, Belgium, is underlain by clean quartz sand to a depth of about 30 meters. An accident at one of the nuclear facilities, which could contaminate the ground water, would entail serious consequences, since the movement of radioactive contaminants through the ground would be retarded or reduced only slightly by adsorption. Test drilling showed that the water table aquifer is composed of two sand formations, the upper Mol sand being somewhat coarser grained and therefore probably more permeable than the underlying Casterle sand. The lower part of the Mol sand contains a number of thin clay layers which make a partial hydrologic barrier between the two formations, dividing the water table aquifer into two parts. A test well was installed, screened through the full thickness of both sands, and test pumped. Drawdowns were measured in observation wells screened both in the Mol sand and in the Casterle sand. A tracer was added to four of the observation wells in turn, and the arrival of the tracer was measured in the pumped well. The average travel times in the Mol and Casterle sand were used to determine the amount of water being produced from each by the pumping, and these data, with the observed drawdowns, were used to calculate the transmissibility, the permeability, and the storage coefficient of each of the two formations. Using these parameters, the designs of several well systems for pumping contaminated ground water out of the aquifers are discussed. Pumping out, or scavenging, the contaminated ground water and decontaminating it appears to be a practical method of resolving some of the problems that would be raised by a nuclear accident in the Mol area. (auth)

31477 DETERMINATION OF AGES AND URANIUM CONTENT OF SOME MINERALS AND GLASSES BY FISSIONTRACK REGISTRATION. Nishimura, Susumu (Univ. of Osaka Prefecture). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 223-5(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The recent development of the fission track technique for dating minerals and glasses offers the geologist and archaeologist a new inexpensive tool for the dating of the igneous event, vestiges and relics. There is usually one or more kinds of mineral, present in the common igneous rocks, tuffs, baked earths, tiles and pottery, which can be used for the fission track method of dating. Suitable minerals include biotite, hornblende, apatite, zircon and muscovite. Dating data obtained in Japan are presented. (auth)

31478 APPLICATION OF RARE EARTH CHELATE COMPOUNDS AS ACTIVABLE TRACER TO TIDAL RIVER FLOW STUDY. Horiguchi, Yasuhiro; Nagatsuka, Sumiko; Suzuki, Hamaji; Nakajima, Kiyoshi; Okano, Yasuhiro; Tabushi, Katsuyoshi (Tokyo Metropolitan Isotope Research Center). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 241-3(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The applicability of rare earth chelate compounds as activable tracers for studying tidal river flow was investigated. Rare earth compounds to which 1 kg EDTA was added were used as activable tracers in the field experiments because the EDTA decreased the sorption loss of the rare earth elements. The relation between the dilution rates of three kinds of activable tracers (NH_4Br, Sm-EDTA, and Eu-EDTA) and the elapsed time after tracer injection is shown, and it is concluded that rare earth chelate compounds are suitable activable tracers for this application. (L.C.L.)

31479 EVALUATION OF GROUND WATER RESOURCES BY TRITIUM DATING. Ochiai, Toshio; Kawasaki, Hironao. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 253-4(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Tritium dating was used to estimate the age of ground waters in plains areas of Japan and to make a quantitative evaluation of ground water resources. The method used and results are presented. (L.C.L.)

31480 GAMMA-GAMMA LOGGING FOR HEAVY METALLIC ORE DEPOSIT BY USE OF ^{75}Se. Nakai, Junji (Geological Survey of Japan, Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 255-7(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Studies were performed to determine the applicability of γ-γ logging to the detection of heavy metallic ore deposits. Selenium-75 was used as a suitable gamma source, and the relative intensity of the scattered gamma radiation in the ore deposit model for a point source was numerically calculated according to the diffusion equation. The scattered gamma ray spectra for ^{60}Co, ^{137}Cs, and ^{75}Se were measured by a gamma spectrometer. (L.C.L.)

31481 PULSED NEUTRON LOGGING. Itoh, Toshinobu (Japan Petroleum Development Corp., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 258-60(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The principles of pulsed neutron well logging are described, and some applications of the method are discussed. (L.C.L.)

31482 AFFINITY OF ISMAILIA CANAL BOTTOM SEDIMENTS FOR CERTAIN RADIONUCLIDES. Mahmoud, K. A.; Yousef, Y. A.; Abdel-Kerim, N. I.; Abdelmalik, W. E. Y. Isotope Radiat. Res.; 1: 9-18(Oct 1968).

The ecological environment of the Ismailia Canal, which runs for a distance of more than one kilometer adjacent to the Western boundaries of the U.A.R. Atomic Energy Establishment site, was studied. Laboratory investigations on Canal water and bottom sediments were performed. The Canal water is moderately hard with low mineral content and limited changes in pH and dissolved solids. Most of the bottom sediments were fine sand and composed of quartz and feldspar, as shown by x-ray diffraction. However, montmorillonite clay mineral was identified in the clayey silt fraction. Cation exchange capacities of samples from bottom sediments were moderately low and exchange capacities were highest in the clay-size fraction. Laboratory studies, using slurry tests, on sorption of some radionuclides such as ^{134}Cs, ^{89}Sr, and ^{60}Co by bottom sediments were conducted. Affinity of these sediments for sorption of radionuclides were influenced by grain-size distribution, contact time and carrier concentration. Linear relationships were noticed between logarithm of capacity of bottom sediments for sorption of radionuclides versus logarithm of carrier concentration. A Freundlich sorption isotherm was identified. (auth)

31483 RELATIONSHIP BETWEEN ACCURACY AND SENSITIVITY OF NUCLEAR GEOPHYSICAL METHODS. Blankov, E. B.; Filippov, E. M. Geol. Geofiz.; No. 3, 76-82(1969). (In Russian).

Relationships are derived for estimating the error in measuring a given component in rocks by nuclear geophysical methods. For a linear dependence of measured counting rate on a given value of the component in the rock, a relationship is derived for the sensitivity threshold of the nuclear geophysical methods, and individual special cases are examined. A relationship applicable to activation methods of investigating the composition of rocks containing several isotopes to be determined is also derived. (Geophys. Abstr.)

Meteorology

Refer also to abstracts 31241, 31450, 31526, 31528, 31808, 31888, 31890, 31960, 31964, 31984, and 32002.

31484 (ANL-7489, pp 87-98) METEOROLOGICAL STUDIES. (Argonne National Lab., Ill.).

In support of the Air Pollution Modeling Project at Argonne National Laboratory, the Meteorology Group has helped to acquire and process meteorological data for the data file, planned a series of experiments to gather meteorological and dispersion data in Chicago, begun to identify Chicago weather regimes important in air pollution, and sought the cause of wind direction differences between Midway Airport and the TAM stations. The equipment and methods used for making the meteorological measurements are described, and the development of a computer model to predict SO_2 levels over Chicago on a real time basis is discussed. (L.C.L.)

31485 (CEX-59.4,13) AERORADIOACTIVITY SURVEY AND RELATED SURFACE GEOLOGY OF THE CHICAGO AREA, ILLINOIS AND INDIANA (ARMS-I). Flint, George M. Jr.; Pitkin, James A. (Geological Survey, Washington, D. C. Division of Biology and Medicine (AEC), Washington, D. C.). Jun 1970. 25p. Dep. CFSTI.

An aeroradioactivity survey of the Chicago area, Illinois and Indiana, was made in 1960 by the U. S. Geological Survey for the U. S. Atomic Energy Commission. Continuous radioactivity profiles were obtained with scintillation-counting equipment at approximately 500 feet above the ground on parallel east-west flight lines spaced 1 mile apart. A map of aeroradioactivity units was prepared from the profiles. The gamma radiation data indicate a moderate range in the levels of natural radioactivity and only a very general correlation with the surface geology. The entire area surveyed is covered by glacial deposits and loess of Pleistocene age. Bedrock exposures of the underlying sedimentary rocks of Cambrian through Pennsylvanian age are sparse. Distinct radioactivity lows are associated with areas of sand (outwash deposits) in the eastern part of the area surveyed. Elsewhere only correlations are made with the glacial morainal, drift, and lacustrine deposits. (auth)

31486 (IAN-RS-ERA-4) ENVIRONMENTAL RADIOMETRIC STUDY IN COLOMBIA DURING 1968. Hernandez, J. A.; Tejada, M. C.; Usme, V. A.; Gonzalez, G. (Instituto de Asuntos Nucleares, Bogota (Colombia). Seccion Estudio Radiometrico Ambiental). 1969. 54p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

General information on the results obtained on the measurement of the radioactive fallout in Colombia during 1968 is presented. The present organization of the Radiometric Study of the Environment in the country is described. The methods used for the analysis of samples of the food chain and the contribution of nuclear testing which took place in the previous year are described. The results for 1967 and 1968 are compared. The dose received per person during the period of highest concentration was evaluated. The numerical results of measurements on the β and γ activity of the physical medium and the biological medium or food chain are presented for each month of the year. (tr-auth)

31487 (JUL-637-ST) ENVIRONMENTAL CONTAMINATION AND RADIATION BURDEN THROUGH RADIOACTIVE EXHAUST FROM NUCLEAR FACILITIES. Vogt, Kurt Juergen (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Strahlenschutz). Jan 1970. 227p. (In German). Dep. CFSTI (U. S. Sales Only).

The environmental dangers of nuclear facilities from radioactive materials released into the atmosphere were studied. The propagation of exhausts into the atmosphere, assumed to be homogeneous but anisotropic, was considered theoretically. The meteorological relations and parameters necessary for the evaluation of the propagation equations were discussed. Radioactive emissions for all fission products released as a result of reactor incidents were considered. The propagation equations for all practically occurring parameter combinations (source distances, diffusion categories, emission heights, decay constants, washout and fallout constants) were numerically evaluated. The basis for the evaluation of the environmental burden and a concept for application of this concept to nuclear facilities were given. (J.S.R.)

31488 (NIRS-RSD-22, pp 13-19) DATA OF THE EIGHTH NUCLEAR TEST OF THE PEOPLE'S REPUBLIC OF CHINA. (National Inst. of Radiological Sciences, Chiba (Japan)).

The gross β radioactivity in rain, dry fallout, and the upper air of Japan following the Chinese nuclear tests of December 1968 is reported. Graphs, maps, and tables are used for presentation of data. (C.O.)

31489 (NP-18212) BELGIAN-NETHERLANDS ANTARCTIC EXPEDITIONS, 1964 AND 1965. ATMOSPHERIC RADIOACTIVITY. I. IN THE OCEAN, DECEMBER 8, 1963-JANUARY 16, 1964. II. AT ROI BAUDOUIN BASE, APRIL 2, 1964-JANUARY 15, 1965. III. AT ROI BAUDOUIN BASE, FEBRUARY 4, 1965-JANUARY 31, 1966. Wilgain, S.; Picciotto, E.; Deschamps, J.; Ketelers, R. (Brussels Univ. (Belgium)). 1968. 55p. (In French). Dep. CFSTI (U. S. Sales Only).

The measurement and calculation methods used for the determination of the atmospheric and sea activity are described. The detailed results of the measurements made during the summer of 1963-64 and during wintering at the Roi Baudouin Base in 1964 and 1965 are presented. (J.S.R.)

31490 GEOGRAPHIC VARIATIONS OF THE LARGE-SCALE VERTICAL EXCHANGE SPEED. Nguyen Ba Cuong; Lambert, Gerard (CNRS, Gif-sur-Yvette, France). J. Geophys. Res.; 75: 2877-84(20 May 1970).

From a global study of the radioactive fallout in the latitude range 30°-60°N during the period 1963 to 1967 five regularly spaced areas have been found in which the amount of nuclear debris is somewhat higher than the average. This phenomenon may be attributed to an inhomogeneity in the rates of exchange between the lower stratosphere and the mid-troposphere, possibly related to the standing waves of the polar jet stream. At lower altitudes the existence of a continental threshold layer, which is characterized by a lower coefficient of vertical exchange, gives rise to an excess of dry fallout over the oceans. This may explain the discrepancies in measurements of the amount of radioactive fallout over continental areas and over oceanic areas at the same latitude, as observed by various authors. (auth)

31491 USE OF ^{210}Pb AS A TRACER OF TRANSPORT PROCESSES IN THE STRATOSPHERE. Feely, Herbert W. (Queens Coll., Flushing, N. Y.); Seitz, Harold. J. Geophys. Res.; 75: 2885-94(20 May 1970).

Short-term changes in the distribution of ^{210}Pb in the lower

stratosphere result from variations in the rates of transport processes within and between the troposphere and the stratosphere. As a result, ^{210}Pb should be of use as a tracer of such processes. The highest concentrations of ^{210}Pb in the stratosphere are found within a layer several kilometers thick that lies immediately above the tropopause. Experiments with a simplified numerical model of atmospheric transport indicate that this distribution could result from an equilibrium between eddy diffusion and particle settling. ^{210}Pb concentrations within this layer decreased during the winter of 1964 to 1965 and increased during the summer of 1965, perhaps as a result of seasonal variations in the rates of vertical transport of radon in the troposphere. ^{210}Pb concentrations in the region immediately above this layer in the polar stratosphere also decreased during the winter of 1964 to 1965, probably as a result of general subsidence of air within sections of the polar stratosphere. These observations suggest that ^{210}Pb may be of value in tracing the exchange of air between the troposphere and the stratosphere and in tracing vertical transport within the polar stratosphere. (auth)

31492 ^{37}Ar, ^{39}Ar, AND ^{81}Kr IN THE ATMOSPHERE AND TRACER STUDIES BASED ON THESE ISOTOPES. Loosli, H. H.; Oeschger, H.; Wiest, W. (Univ., Bern). J. Geophys. Res.; 75: 2895-2900(20 May 1970).

Results of monthly measurements of the tropospheric ^{37}Ar activity during 1969, as well as measurements of the atmospheric activities of the recently detected isotopes ^{39}Ar and ^{81}Kr, are presented. Applications of these isotopes for tracer studies in the atmosphere and in water reservoirs, for the determination of production rates and for studying the constancy of the cosmic radiation flux, are discussed. (auth)

31493 TRANSPORT OF AIR IN THE STRATOSPHERE AS REVEALED BY RADIOACTIVE TRACERS. Bhandari, Narendra (Tata Inst. of Fundamental Research, Bombay). J. Geophys. Res.; 75: 2927-30(20 May 1970).

The available measurements on cosmogenic ^{7}Be and artificial tracers ^{109}Cd and ^{238}Pu in the atmosphere are discussed in terms of plausible circulation patterns in the stratosphere and across the stratopause. The ^{7}Be data in the northern hemisphere between 24 and 37 km, when integrated with the aircraft data from lower altitudes, suggest an equatorward transport of polar air above 25 km during the winter of 1965. Such a motion does not seem to be operative below 24 km. There are cyclic variations in the concentration of ^{109}Cd and ^{238}Pu in both hemispheres which are out of phase by about six months; in early spring through summer, the concentrations are repeatedly higher than in the fall and winter during 1962-1965 at 34°S and 31°N. These data indicate that the transport across the stratopause is strongly seasonal and probably takes place during an extended spring period. A detailed analysis of tracers injected in the mesosphere further suggests that the dispersion history of the debris injected in the mesosphere strongly depends on the time of injection. (auth)

31494 DAILY VARIATIONS IN THE TRITIUM CONCENTRATION OF ATMOSPHERIC MOISTURE. Kigoshi, Kunihiko; Yoneda, Kazuo (Gakushuin Univ., Tokyo). J. Geophys. Res.; 75: 2981-4(20 May 1970).

Observed daily variations in the tritium concentration of atmospheric moisture collected in Tokyo from May 10 to June 2, 1966, and from July 12 to August 6, 1968, are presented. The relation between tritium concentration variations and the movement of air masses over Tokyo is discussed. High tritium concentrations indicate the arrival of continental air masses from the north, and low tritium concentrations indicate the presence of oceanic air masses. The tritium concentrations in tropical low-pressure air masses were nearly equal to that of surface ocean water. (auth)

31495 ORIGINAL USE OF THE RADIOACTIVE TRACER GAS ^{85}Kr TO STUDY THE MERIDIAN ATMOSPHERIC FLOW. Pannetier, R. (CEA, Fontenay-aux-Roses, France). J. Geophys. Res.; 75: 2985-9(20 May 1970).

Krypton-85 (^{85}Kr) is a radioactive inert gas with a half-life of 10.4 years; after it enters the atmosphere, this gas disappears only by radioactive decay. It originates mainly from the continuous, ever increasing wastes from fuel reprocessing plants, almost all of which are located in the zone 45°-55°N. By using ^{85}Kr as a tracer, the masses of air exchanged between zones can be evaluated. (auth)

31496 MODEL INVESTIGATION OF THE TIME-DEPENDENT DISTRIBUTION OF RADON. Huss, A. (Hebrew Univ., Jerusalem); Segal, M.; Assaf, G. J. Geophys. Res.; 75: 3020-6(20 May 1970).

A three-level quasi-geostrophic model of the atmosphere has been used to obtain a three-dimensional time-dependent radon distribution. Several experiments were performed in which radon was introduced at the lowest level. The sources were distributed uniformly either over the whole region or over half of the total region. The distribution of radon responded quite realistically to the large-scale atmospheric flow and particularly to the convergence-divergence patterns, i.e., to the distribution of the vertical components of the motion. (auth)

31497 SEASONAL VARIATION IN THE CONCENTRATION OF ^{90}Sr IN RAIN AND ITS DEPENDENCE ON LATITUDE. Ehhalt, D. H.; Haumacher, G. (Univ., Heidelberg). J. Geophys. Res.; 75: 3027-31(20 May 1970).

Seasonal variations in strontium-90 deposition averaged over latitudinal belts 10° wide were calculated from the monthly means obtained from the Health and Safety Laboratory rainfall network and averaged over four years, 1963-1966 inclusive. Similar calculations were made for the ^{90}Sr concentration in rain and a deposition corrected for the seasonal variation in rainfall. In the northern hemisphere the seasonal variation of the ^{90}Sr concentration and the rainfall corrected deposition exhibit the same systematic trend. A southern mode, which has reached a maximum ^{90}Sr deposition in March, seems to exist, as well as a northern mode which does not reach a maximum before June. The seasonal variations at intermediate latitudes change gradually from one pattern to the other. (auth)

31498 EVOLUTION OF THE ISOTOPIC COMPOSITION OF ATMOSPHERIC WATERS IN THE MEDITERRANEAN SEA AREA. Gat, J. R.; Carmi, I. (Weizmann Inst. of Science, Rehovot, Israel). J. Geophys. Res.; 75: 3039-48(20 May 1970).

The isotopic composition of rain in the Levant is a reflection of the modification of continental air masses by interaction with the warm Mediterranean Sea. The detailed pattern of evolution of Levantine air has been studied by an isotopic survey of rain from twenty coastal and island stations in the eastern Mediterranean Sea area. The changes in tritium, deuterium, and oxygen 18 concentrations as a function of the distance from the coast usually differ from those calculated for a continuous air mass modification model. Rather, the major changes occur in the Aegean Sea and along the Turkish coast, in an area of major cyclogenesis. A model of convergent air masses, based on the synoptic patterns, is more consistent with the observed isotopic composition of atmospheric waters in the area. (auth)

31499 WATER VAPOR, MOLECULAR HYDROGEN, METHANE, AND TRITIUM CONCENTRATIONS NEAR THE STRATOPAUSE. Scholz, T. G.; Ehhalt, D. H.; Heidt, L. E.; Martell, E. A. (National Center for Atmospheric Research, Boulder, Colo.). J. Geophys. Res.; 75: 3049-54(20 May 1970).

Concentrations of molecular hydrogen, methane, and water vapor were determined in a 9.3-mole air sample, collected over an altitude interval between 44 and 62 km with a liquid hydrogen cooled cryocondenser on NASA Aerobee flight 4.130 UA, September 4, 1968, over White Sands, New Mexico. The results of gas chromatographic analysis for the volume concentrations of molecular hydrogen and methane were 0.4 ppmv and <0.05 ppmv, respectively. Deuterium and tritium analyses of two water vapor fractions, recovered from the sampler at room temperature and at a higher bakeout temperature, indicated the admixture of water desorbed from the interior sampler surface and were used to distinguish between high-altitude water vapor and the desorbed fraction. By this means, the stratopause water vapor concentration was determined to be between 3 and 10 ppmv. The corresponding tritium concentration in the water vapor near the stratopause is in the range of 80 to 22 million tritium units (TU). The measured specific tritium activity of the stratospheric air sample was 1035 dpm/kg air, two orders of magnitude higher than the estimated level of natural tritium from cosmic-ray production. (auth)

31500 CONTROL OF VERTICAL TRANSPORT OF AEROSOLS BETWEEN 700 AND 3000 METERS BY LAPSE RATE AND FINE STRUCTURE OF TEMPERATURE. Reiter, R.; Sladkovic, R. (Fraunhofer-Gesellschaft, Garmisch-Partenkirchen, Ger.). J. Geophys. Res.; 75: 3065-75(20 May 1970).

The vertical-mass-exchange coefficient was determined from aerosol measurements by two independent methods over a considerable period of time. Well-substantiated relationships between the exchange coefficient and meteorological parameters were found to exist in the lower troposphere between 700 and 1800 meters. The first of the two methods consists of measuring RaB concentration in air at 700, 1800, and 3000 meters; the second is soundings of total air conductivity between 700 and 1800 meters. In the first method, mean exchange coefficients were computed from RaB concentration gradients. In the second, the air conductivity data were used to compute particle concentration profiles, from which incremental exchange coefficients can be com-

puted for thin-layer increments. The mean exchange coefficient for the 700- to 1800- and the 1800- to 3000-meter layer is found to be a function of the average temperature lapse rate in the respective layer. The exchange coefficient of an inversion layer is a function of the greatest inverse lapse rate existing in any part of the inversion. Vertical aerosol transport through a layer of any thickness is primarily determined by the lowest incremental mass-exchange coefficient of any thinner layer contained therein. (auth)

31501 APPLICATION OF SHORT-LIVED COSMOGENIC RADIONUCLIDES AS TRACERS OF IN-CLOUD SCAVENGING PROCESSES. Perkins, R. W.; Thomas, C. W.; Young, J. A. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. J. Geophys. Res.; 75: 3076-87(20 May 1970).

Measurements of the cosmogenic radionuclides ^{38}Cl (37.3 min half-life), ^{39}Cl (55 min), and ^{24}Na (15 hours) in consecutive rainwater samples during storms have provided a basis for studying precipitation formation processes. These radionuclides, which result from cosmic-ray spallation of atmospheric argon, "label" the natural aerosols, and can thus serve as tracers of in-cloud scavenging. Rain collected on a 450-meter^2 polyethylene sheet is continuously passed through ion exchange beds, which retain the radionuclides. Subsequent direct counting of the beds by selective coincidence counting techniques allows their direct measurement. Analysis of rain samples collected over consecutive periods as short as 10 min has established several basic relationships from which the rates and possible mechanisms of various in-cloud precipitation formation and scavenging process are determined. (auth)

31502 ^{14}C CONCENTRATIONS IN THE ATMOSPHERE AND CARBON DIOXIDE EXCHANGE RATES. Walton, A.; Ergin, M.; Harkness, D. D. (Glasgow Univ.). J. Geophys. Res.; 75: 3089-98(20 May 1970).

Although the exchange of CO_2 between the various reservoirs of the carbon cycle has been studied extensively, there remains considerable uncertainty about the values of the exchange rate parameters. With the cessation of large-scale atmospheric nuclear tests in 1962 (subsequent atmospheric tests by France and China contributed relatively small quantities of ^{14}C to the atmospheric reservoirs), a unique opportunity existed for an extended study of these parameters. During 1967–1969, ^{14}C concentrations, as measured in the troposphere and the lower stratosphere, continued to show a steady decline from the peak values found in 1963 in the northern hemisphere. By the end of 1968 the troposphere had become well mixed ($\Delta \simeq 50\%$), but higher concentrations prevailed in the stratosphere. Future concentrations in the atmosphere are expected to decrease steadily as exchange of CO_2 in the dynamic carbon cycle equilibrates the bomb ^{14}C throughout the various reservoirs. The residence times of CO_2 in atmospheric and oceanic reservoirs have been redetermined in this study through the use of a number of "cyclic" and "chain" box models. It appears that the results are not materially affected by modifications of the basic model. The movement of carbon in the biospheric and oceanic reservoirs requires further evaluation, and an increased emphasis on ^{14}C measurements in these areas would appear necessary. (auth)

31503 LARGE-SCALE DISPERSION OF CLUSTERS OF PARTICLES IN VARIOUS FLOW PATTERNS. Kao, S.-K.; Henderson, Donald (Univ. of Utah, Salt Lake City). Contract AT(11-1)-1585. J. Geophys. Res.; 75: 3104-13(20 May 1970).

An investigation is made of the relative particle displacement tensor, eddy diffusivity, power spectra, and cospectra of the relative particle velocities for clusters of particles released in six flow patterns: cyclonic and anticyclonic centers, and trough, ridge, and inflection points to the east and west of troughs in the midtroposphere. It was found that the zonal component of the eddy diffusivity is about five times the meridional component, and the eddy diffusivity for the winter is greater than that for the summer. The zonal component of the eddy diffusivity is greatest for releases at the inflection point to the west of troughs, whereas the meridional component is greatest at cyclonic centers. The smallest value of both the zonal and the meridional components of the eddy diffusivity is the value for releases at anticyclonic centers. The principal axis of diffusion is mostly oriented WSW–ENE for summer releases and WNW–ESE for winter releases. For large diffusion times, the mean square of the zonal component of the relative particle displacement is approximately proportional to the first power of time, whereas the mean square of the meridional component shows a wavy characteristic, which indicates the effect of the meridional motion of the planetary waves. The power spectra of the zonal component of the relative particle velocities are similar in all cases and show an increase in the turbulent kinetic energy with decreasing frequency, whereas the spectra of the meridional component show an energy peak near 10^{-2} cycles hr^{-1}. In the high-frequency range, the spectra of both the zonal and the meridional components of the relative velocities are inversely proportional to the frequency cubed. (auth)

31504 COMPARISON OF ATMOSPHERIC TRANSPORT MODEL CALCULATIONS WITH OBSERVATIONS OF RADIOACTIVE DEBRIS. Krey, P. W.; Krajewski, B. (Atomic Energy Commission, New York). J. Geophys. Res.; 75: 2901-8(20 May 1970).

A semi-empirical box model of atmospheric transport that permits the calculation of stratospheric inventories, surface air concentrations, and deposition of debris injected into the stratosphere, mesosphere, or higher levels has been developed. The model divides the atmosphere of each hemisphere into three compartments: the atmosphere above 21 km, the stratosphere below 21 km, and the troposphere. The transfer between compartments follows first-order kinetics, although the season and height of injection regulate the onset of the transfer. The model adequately computed the fallout parameters of the specific injections of ^{102}Rh, ^{109}Cd, ^{238}Pu, and ^{90}Sr from the 1961–1962 tests, and ^{90}Sr from the sixth Chinese nuclear test in June 1967. It also predicted the 1969 fallout from the recent atmospheric tests. (auth)

31505 INSTRUMENTAL ANALYSIS FOR TRACE ELEMENTS PRESENT IN CHICAGO AREA SURFACE AIR. Brar, S. S. (Argonne National Lab., Ill.); Nelson, D. M.; Kline, J. R.; Gustafson, P. F.; Kanabrocki, E. L.; Moore, C. E.; Hattori, D. M. J. Geophys. Res.; 75: 2939-45(20 May 1970).

On April 4, 1968, surface air particulates were collected on cellulose fiber filters simultaneously at twenty-two different locations throughout the Chicago metropolitan area. A 1-cm^2 portion of each filter was irradiated with thermal neutrons in Argonne National Laboratory's CP-5 research reactor. The neutron-induced nuclides were analyzed by γ-ray spectrometry with 10.2 cm × 10.2 cm (4 in. × 4 in.) and 7.6 cm × 7.6 cm (3 in. × 3 in.) cylindrical NaI(Tl) crystals and a 400-channel analyzer. By varying the neutron flux and the time of irradiation, we were able to detect by purely instrumental means twenty trace elements in surface air. The following elements, listed in decreasing order of concentration, were present: iron, chlorine, aluminum, zinc, manganese, sodium, bromine, vanadium, chromium, antimony, mercury, selenium, cerium, silver, cobalt, lanthanum, scandium, cesium, and europium. The average concentrations varied from 2400 to 0.12 ng/m^3 air. Calcium concentrations in air were not quantitated. (auth)

31506 INVESTIGATION ON CORRELATIONS BETWEEN FRACTIONATION EFFECTS AND PARTICLE SIZE DISTRIBUTIONS IN FISSION PRODUCT SAMPLES. Peters, Wolfgang; Paffrath, Dieter (Institut fuer Physik der Atmosphaere, Wessling, Ger.). J. Geophys. Res.; 75: 2991-8(20 May 1970).

After the third Chinese nuclear bomb test, radioactive aerosol was collected on fiber filters from the atmosphere at different altitudes. By comparing the measured β^--decay curves with the theoretical β^--decay curves the fractionation factor of the fresh fission products and the activity of ^{237}U in the samples were determined. Furthermore, the samples were autoradiographed and the spot-size distribution and background blackening of the autoradiographs were measured. By evaluating the particle sizes (particle activities) from spot sizes and by comparing the results of β^--decay curve analysis and of the autoradiographs it is shown that there is a relation between fractionation degree and particle-size distribution; nuclides originating from volatile precursors are enriched in small particles, and nuclides from refractory precursors are enriched in large particles. Uranium-237 is also enriched in small particles and fractionates like nuclides descending from volatile precursors. (auth)

31507 TRACE ELEMENT CONCENTRATIONS IN THE TROPOSPHERE AND LOWER STRATOSPHERE. Rancitelli, L. A.; Perkins, R. W. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. J. Geophys. Res.; 75: 3055-64(20 May 1970).

A technique has been developed and applied to establish the gradient of several trace elements from the troposphere through the lower stratosphere. U.S. Air Force planes during routine sampling flights performed aerosol collections over a two-year period at altitudes of 3 to 15 km between 37°N and 46°N. The concentrations of Ag, Co, Cr, Fe, Sb, Sc, and Zn measured by instrumental neutron-activation analysis showed gradients of tenfold to one hundredfold over the altitude range. Concentrations at a given altitude varied by severalfold as a function of time. A comparison of the relative concentrations observed in the atmosphere with those in metropolitan aerosols, the earth's crust, sea water, and rainwater collected at points remote from possible sources of

pollution indicates that, although the atmospheric Fe, Co, and Sc are compatible with the injection of material from the earth's crust, the concentrations of Ag, Cr, Sb, and Zn in the atmosphere are too high to have originated from the natural sources considered. Of nineteen elements measured in rainwater, it appears that the only elements that could originate primarily from the oceans are Na, Cl, and Br. (auth)

31508 DATA. SECTION IV. OTHER DATA. Radiol. Health Data Rep.; 10: 577-85(Dec 1969).

The results from routine sampling of biological materials and other media are presented. Included are: 1961 to 1968 measurements of the alpha radioactivity in air in Colorado uranium mines, the ^{90}Sr content of human bone in the USA during Oct. to Dec. 1968, and environmental radioactivity monitoring data for the Mound Laboratory July through Dec. 1968 and for the General Electric Company, Neutron Devices Dept., Jan. through June 1968. Nuclear detonations for Nov. 1969 are also reported. (L.C.L.)

31509 DATA. SECTION III. AIR AND DEPOSITION. Radiol Health Data Rep.; 10: 515-22(Nov 1969).

Tabulated data from July 1969 measurements of the gross beta activity in surface air and precipitation at 73 locations in the USA and 24 in Canada, and in air only at 16 stations in Mexico and 12 locations in South America are presented. (L.C.L.)

31510 DATA. SECTION III. AIR AND DEPOSITION. Radiol. Health Data Rep.; 10: 569-76(Dec 1969).

Tabulated data from August 1969 measurements of the gross beta activity in surface air and precipitation at 73 locations in the USA and 24 in Canada, and in air only at 16 stations in Mexico and 12 locations in South America are presented. (L.C.L.)

31511 DATA. SECTION IV. OTHER DATA. Radiol. Health Data Rep.; 10: 523-34(Nov 1969).

The results from routine sampling of biological materials and other media are presented. Included are: Jan. through Feb. 1969 measurements of the ^{131}I content in bovine thyroid obtained at sampling stations in 17 states of the USA, and environmental radiation monitoring data for July through Dec. 1969 at the Portsmouth, Ohio area and Savannah River Plant area in S. C.. Nuclear detonations for Oct. 1969 are also reported. (L.C.L.)

31512 PROBABILITY TREATMENT OF ATMOSPHERIC DISPERSION FOR DOSE CALCULATIONS. Woodard, Keith (Pickard, Lowe and Associates, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 216-17(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31513 MEASURED DOSE DISTRIBUTION DUE TO A 14-MeV NEUTRON SOURCE IN THE AIR-GROUND GEOMETRY. Fritzsche, Allen E. (Edgarton, Germeshausen and Grier, Las Vegas, Nev.). Trans. Amer. Nucl. Soc.; 13: 266(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31514 STATUS OF NEUTRON TRANSPORT IN THE ATMOSPHERE. Straker, E. A. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 267(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Mineralogy and Exploration

Refer also to abstracts 31477 and 32357.

31515 URANIUM ORE DEPOSITS IN THE BELVISO VALLEY. Mittempergher, Mario; Pantanetti, Fabio. Com. Naz. Energ. Nucl., Notiz.; 16: No. 4, 39-51(Apr 1970). (In Italian).

A description of the uranium ore bodies in the Belviso Valley (Lombard Alps) and of the activities of CNEN's organizations in this area is presented. (auth)

31516 PROBLEMS OF URANIUM ORE MINING. Hampel, H.-R. (Urangesellschaft mbH and Co. KG, Frankfurt am Main). pp 5-14 of Der Nukleare Brennstoffkreislauf. Essen; Vulkan-Verlag Dr. W. Classen (1969). (In German).

From Meeting of House of Technology, Essen, Germany. See CONF-690338.

The geology of uranium ore deposits is outlined. Methods of prospecting and exploring for uranium ores are described. Ore deposits in the western world are classified according to production costs. The special problems of mining uranium ore are indicated, and their cost factors are considered briefly. (J.S.R.)

31517 URANIUM ORE DEPOSIT AT MARY KATHLEEN. Hughes, F. E.; Munro, D. L. (Conzinc Riotinto of Australia, Ltd., Melbourne). At. Energy Aust.; 13: 11-17(Apr 1970).

From Symposium on Uranium in Australia, Rum Jungle.

An abstract of this article, prepared from the original, appeared as NSA 23: 40892.

Oceanography

Refer also to abstracts 31363, 31489, and 31663.

31518 (UCSD-34-P-127-7) A CONTINUED STUDY OF THE DEEP CIRCULATION AND DEEP FISH POPULATIONS IN THE PACIFIC OCEAN. Isaacs, John D.; Schwartzlose, Richard A. (California Univ., La Jolla, San Diego). 4 May 1970. Contract AT(11-1)-34. 18p. Dep. CFSTI.

Deep photographs and current measurements were taken to contribute to the understanding of the deep near-bottom ocean environment. Previously the abyssal bottom and near bottom were thought to be nearly devoid of fish life and the steady currents to be only a few mm/sec at the absolute maximum. The photographs have shown active abyssal life to be most plentiful, even at abyssal depths, and the steady currents to be several cm/sec, with tidal and transient currents much higher. A few motion pictures down to 1000 m were made with a newly-developed camera. These photographs show that the most abundant fish to 1000 meters off California and Baja California are the hag fish. The current measurements and the deep fish studies are becoming vital in discussions concerning disposal and pollution near the bottom on the continental shelf and at abyssal depths (for example, war gases), and have been employed by other investigators in examination of potential new fisheries. (auth)

31519 RADIOACTIVITY IN THE SURFACE LAYER OF WATER IN THE BLACK SEA AND ITS RELATIONSHIP TO SOME PHYSICAL CHARACTERISTICS. Konstantinov, V. P.; Gorodnitskii, A. M. Tr. Nauch.-Issled. Inst. Geol. Arktiki; No. 5, 236-9(1968). (In Russian).

Results are presented of radioactivity logging of Black Sea waters carried out in 1966. The curves of radioactivity are qualitatively similar to the pH curves. There are three distinct horizons of higher radioactivity—at 15 to 20 m, 40 to 60 m, and 170 to 180 m depths. Curves of vertical variations of SP at all stations showed two jumps which spatially tended to correspond to the high radioactivity values. The maximum of radioactivity (at 40 m) corresponded to the maximum of turbidity, suggesting that the source of the radioactivity anomaly is of biologic origin. (Geophys. Abstr.)

31520 STUDY OF THE CHRONOLOGY OF DEEP SEA SEDIMENT WITH RADIOISOTOPES. Sugimura, Yukio (Meteorological Research Inst., Tokyo). Nippon Kaiyo Gakkaishi; 25: 261-8(Oct 1969). (In Japanese).

The sedimentation rate and other characteristics of the ocean floors in the western North Pacific, Indian Ocean, and Japan Sea were studied by the $^{230}Th/Th$ method first proposed by Picciotto et al. The samples of 1 to 2 gram from each horizon of deep sea cores were processed with an anion exchange resin to separate the Th isotopes. These isotopes were fixed to an electroplating unit made of platinum, and the α intensity was measured by α-spectrometry. The distribution of surface $^{230}Th/Th$ ratio in the Pacific Ocean showed a remarkable regional difference, and the sedimentation rate in the world oceans was below 10 mm per thousand years. The surface sedimentation rate in the western North Pacific ranges from 0.5 to 7.3 mm/10^3 yr, but the ratio changes sharply at 10^5 yr B.P., suggesting that the rate was greater before the turning point of 10^5 yr. The average rate of 15 mm/10^3 yr was obtained in the equatorial region of the Indian Ocean. The sedimentation rate in the Japan Sea was found to be about ten times as large as the Pacific Ocean, and the distribution of uranium shows a remarkable increase from 10^4 yr B.P. on. The cause of this change was probably due to the glacial eustacy which might control the water exchange in the Japan Sea, and it shows that at the time some oxygen-free conditions were brought about at the bottom of the sea. (NSA of Japan)

Seismology

31521 (HN-20-1037) POSTSHOT STUDY: DYNAMIC RESPONSE OF LASL MOBILE TOWER. Pliers Event. Bachman, R. E. (Holmes and Narver, Inc., Las Vegas, Nev. On-Continent Test Div.). Apr 1970. 111p. Dep. CFSTI.

The LASL Mobile Tower was positioned on an emplacement pad at surface zero for the Pliers event. Eight strong-motion

accelerometers, mounted near or on the tower, measured the ground shock generated by the detonation and the resulting tower response at six locations on the tower. To permit a comparison between the measured response and the response computed by current analytical techniques, an idealized dynamic model was formulated using the properties of the tower. Two analytical techniques (modal superposition and spectral) were then used in conjunction with computer program TDYNE and SPECANAL to compute the vertical response of the tower platforms using measured ground and pad motions as input motions. The inelastic effects of tower jumping and base crushing were also idealized and included in some of the modal superposition analyses. Several dynamic analyses were performed. Peak relative displacements that were within approximately 30 per cent of the measured peak displacements resulted from a modal superposition analysis using the free-surface motion as input motion. The results from this analysis also indicated that the tower jumped vertically approximately 0.4 inches in response to the input motion. (Preshot dynamic analysis utilizing ground motion data from the Stoat event predicted tower jumping of approximately 0.3 inches.) When the emplacement pad motion was used as input motion, computed peak relative displacements differed from the measured peak displacements by as much as 40 percent. For this analysis, the results indicated that the tower jumped vertically 0.2 inches. The inclusion of tower jumping in the analyses improved correlation of the computed relative displacements with the measured displacements, by as much as 30 percent, at all tower stations. The computed peak relative displacements using the spectral analysis technique deviated substantially from measured responses in most instances. This deviation was attributed partly to the fact that the effects of nonlinear jumping could not be included in this analysis technique and partly to the approximate nature of the spectral technique. (auth)

31522 (TID–25438) STUDY OF EARTHQUAKE INPUT MOTIONS FOR SEISMIC DESIGN. Werner, Stuart D. (Agbabian-Jacobsen Associates, Los Angeles, Calif.). Jun 1970. Contract AT(49-5)-3012. 192p. (R–6914–925). Dep. CFSTI.

Procedures for determining seismic input for use in the analysis and design of nuclear power plants were investigated. The study consisted of three primary tasks: procedures for the determination of site-dependent earthquake ground motions, a survey and assessment of existing soil/structure interaction analysis techniques, and a first-level approach to the representation of earthquake ground motions in a region. The results of each task are presented with recommendations for further studies. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 31447, 31504, 31506, 31521, and 32523.

31523 (HN-20-1027) TDYNE: A COMPUTER PROGRAM TO PERFORM MODAL AND TIME DEPENDENT DYNAMIC ANALYSIS OF SPRING-MASS SYSTEMS WITH CRUSHABLE AND JUMPING BASES SUBJECT TO GROUND MOTION. Kennedy, R. P. (Holmes and Narver, Inc., Las Vegas, Nev. On-Continent Test Div.). Jun 1969. 105p. Dep. CFSTI.

TDYNE was developed to study the response of structures to ground motion from underground nuclear explosions. This program determines all desired natural frequencies and mode shapes for any spring mass system with up to 80 lumped masses and 120 springs. Additionally, for any inputted ground motion-time history and modal viscous damping this program determines 1) the relative displacement-time history response for any three masses of the system plus the peak positive and negative displacement responses and their times of occurrence for all masses; 2) the force-time history response for any three springs of the system plus the peak positive and negative force response and their times of occurrence for all springs; 3) the base acceleration-time history; 4) the total jumping and crushing deflection at each time increment; and 5) the dynamic base reaction-time history. (W.H.K.)

31524 (HN-20-1030) SPECANAL: A COMPUTER PROGRAM TO GENERATE RESPONSE SPECTRA, POWER SPECTRAL DENSITY, AND RESPONSE-TIME HISTORIES FOR ELASTIC SINGLE DEGREE OF FREEDOM OSCILLATORS WITH VISCOUS DAMPING SUBJECTED TO DIGITIZED GROUND MOTION-TIME HISTORIES. Kennedy, R. P. (Holmes and Narver, Inc., Las Vegas, Nev. On-Continent Test Div.). Oct 1969. 161p. Dep. CFSTI.

The response spectra which can be generated are peak positive, peak negative, and absolute peak relative displacement, relative velocity, and absolute acceleration. Time of occurrence of each of these peak responses are outputted. Pseudo relative velocity and pseudo absolute acceleration response spectra may also be generated. All response spectra are outputted as a function of natural frequency and viscous damping ratio. Whenever the peak structural responses occur in the free vibration era after the inputted ground motion these peak free vibration responses are automatically calculated and incorporated into the response spectra. Thus there is no requirement for incorporating the free vibrations era into the inputted ground motion record. Power spectral densities as a function of natural frequency may be generated for either the entire inputted ground motion record or for any portion of this record. For specific natural frequencies and damping ratios both plotted and printed displacement response-time histories can be obtained. Plotted and printed output of the inputted ground motion record as well as its first and second integral can also be obtained where applicable. Either card or tape inputted digitized ground motion data are acceptable. These ground motion data may be either an acceleration or velocity time history record and do not have to be digitized at equal time increments. SPECANAL was developed for use in conjunction with a study of the response of structures to ground motion from underground nuclear explosions. (auth)

31525 (NCG-TM-67-1) PREDICTION OF GAMMA EXPOSURE RATES IN LARGE NUCLEAR CRATERS. Tami, T. M.; Day, W. C. (Army Engineer Nuclear Cratering Group, Livermore, Calif.). 1967. 22p. (CONF-700101-17). Dep. CFSTI.

From Meeting on Engineering with Nuclear Explosives, Las Vegas, Nev.

A method for predicting the gamma exposure rates within and on lip areas of large craters produced by underground nuclear explosions was developed using the following successive steps: a uniform distribution of the radioactive debris in the upper portions of the fallback and ejecta was assumed; a uniform infinite slab source was used to analytically calculate the exposure rate and was shown to be applicable in the crater and lip area; this calculated exposure rate was then normalized to previously measured values of exposure rate in and around several nuclear craters; and, finally, exposure rates in and around future nuclear craters were calculated. Each step is discussed. Determination of the source density, crater volume, effect of time on the exposure rate, and the contribution of fission products and induced radioisotopes to the exposure rate are considered. The method is applied to the Schooner Event, and the results are compared with measured exposure rates. (L.C.L.)

31526 (UCRL-50230(Rev.1)) RADIOACTIVITY RELEASED FROM UNDERGROUND NUCLEAR DETONATIONS: SOURCE, TRANSPORT, DIFFUSION, AND DEPOSITION. Knox, Joseph B.; Tewes, Howard A.; Crawford, Todd V.; Gibson, Thomas A. Jr. (California Univ., Livermore. Lawrence Radiation Lab.). 2 Mar 1970. 113p. Dep. CFSTI.

Predicting both the close-in external gamma-radiation field produced by a subsurface nuclear explosive and the concentration of airborne radionuclides at long ranges, including changes in the diffusion of the cloud is discussed. To elucidate the predictive methods, the basis of and the most recent results are presented from the computational physics models of the radionuclides produced (the source), the transport and simultaneous lateral eddy diffusion of the radionuclides initially in the stabilized cloud (the KFOC model), the development of the main nuclear cloud (the GEM and TENSOR models), and the two-dimensional atmospheric diffusion of the initial cloud through a time- and space-dependent diffusion environment (the 2BPUFF model). The calculated results have been compared to observed data in order to develop estimates of reliability as well as indications of key areas that need further investigation. (auth)

31527 (UCRL-50853) SUMMARY OF NUCLEAR EXPLOSION DATA FOR UNDERGROUND ENGINEERING APPLICATIONS. Higgins, Gary H. (California Univ., Livermore. Lawrence Radiation Lab.). Apr 1970. 8p. Dep. CFSTI.

Forty-five events conducted by the United States for a variety of programmatic purposes were selected for inclusion in this summary. Pertinent data were collected for these events, including depth of burst; depth to water table; depth to Paleozoic rock formation; medium of explosion; yield of the event; cavity radius formed by expansion of the rock; chimney height formed above the detonation point; and the purpose of the nuclear detonation. Also prepared were summary tables of the generalized characteristics of a variety of rocks, the quantity of rock vaporized and melted, and the preshot/postshot permeability of rock from four events: Handcar, Hardhat, Pile Driver and Salmon. (auth)

31528 ESTIMATION OF THE ELAPSED TIME AFTER NUCLEAR EXPLOSION BY MEASURING ACTIVITY RATIO OF ^{95}Zr AND ^{95}Nb IN THE RADIOACTIVE FALLOUT. Fujii, I.; Onodera, K. (Tokyo Shibaura Electric Co., Ltd.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 95-7(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A method for estimation of the elapsed time after nuclear explosion from a given radioactive fallout was developed wherein activities of ^{95}Zr and ^{95}Nb belonging to the same decay chain in fission products are measured by the Ge(Li) gamma detector, and the elapsed time is calculated from their activity ratio. The experimental results obtained from a neutron irradiated uranium sample and from radioactive fallout which has been found in Nagano City, Japan, after the nuclear explosion experiment in China, were in good agreement with theoretical values. The method can be applied to estimation of history or origin on a given fallout. (auth)

31529 SOME NASA MISSIONS EMPLOYING RADIOISOTOPE HEAT SOURCES. Manson, S. V.; Rochen, H. (National Aeronautics and Space Administration, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 65(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Facilities and Equipment

Refer also to abstracts 31614, 31633, 31637, 31652, 31653, 31655, 31657, 31658, 31660, 31661, 31756, 31761, 31762, 32348, 32419, 32425, 32440, 32792, 32804, and 33076.

31530 (BNWL-1303) OPEN- AND CLOSED-LOOP TOP CLOSURE REMOTE CUTTING AND WELDING EVALUATION. Gilmore, R. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT(45-1)-1830. 122p. Dep. CFSTI.

One of the prime objectives of the FFTF is to perform nuclear fuels testing. The facility must have the capability to install and remove test assemblies by remotely controlled equipment. The development and testing of equipment with which to weld and cut the open- and closed-loop reactor top closures for removal and reinstallation of experimental test assemblies is discussed. (auth)

31531 (CTC-29) FINITE ELEMENT MODEL WITH APPLICATIONS TO BUILDINGS K-33 AND K-31. Smith, C. V. (Union

Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 1 Jun 1970. Contract W-7405-eng-26. 109p. Dep. CFSTI.

The theory of the finite element technique is first presented for any problem which can be described by a variational principle. The procedure is then applied to the beam and rectangular plate bending elements, with the mass and stiffness matrices and the loading vectors presented for each element. There is next a discussion of the structural modeling of the K-33 and K-31 building cell floor systems, which is necessary in order to utilize the finite elements as derived. This particular phase is in conjunction with the program for expansion of the gaseous diffusion plant capacity. Also, a method is presented which can be used to reduce the size of the eigenvalue problems when calculating mode shapes and frequencies of free vibration. (auth)

31532 (LA-4435) NUMERICAL SIMULATION OF A COLD TRAP FOR SODIUM PURIFICATION. Goplen, B. C.; Biery, J. C.; McPheeters, C. C. (Los Alamos Scientific Lab., N. Mex.). Apr 1970. Contract W-7405-eng-36. 21p. Dep. CFSTI.

The dynamic behavior of a sodium system cold trap was numerically simulated on a digital computer. The simulation accounted for mixing in the hold tank, delay times in pipes, temperature variation with distance in the cold trap, impurity buildup on the walls of the cold trap, and simultaneous precipitation and dissolution of the impurity in different portions of the cold trap. The main purpose of the simulation was to generate mass transfer coefficients from experimental data taken from an experimental sodium loop. The program can also help in the design of sodium systems containing cold traps. (auth)

31533 (LA-4446) SPACE ELECTRIC POWER R AND D PROGRAM. Quarterly Status Report for the Period Ending April 30, 1970. Part I. (Los Alamos Scientific Lab., N. Mex.). May 1970. Contract W-7405-eng-36. 6p. Dep. CFSTI.

Development and testing of a thermoelectric module for direct conversion of heat to electricity is reported. Information is included on potassium-input heat pipe, heat-pipe radiator system development, mercury radiator heat pipe, phenyl ether radiator heat pipes, and mercury input heat pipes. (J.R.D.)

31534 (NYO-3979-3) ADVANCED HEAT PIPE THERMIONIC TECHNOLOGY. TASK I. DEVELOPMENT OF HIGH VOLTAGE MODULE. Final Technical Report, May 1, 1968-September 30, 1969. Longsderff, R. W. (Radio Corp. of America, Lancaster, Pa.). Contract AT(30-1)-3979. 47p. Dep. CFSTI.

The design of a heat pipe-thermionic module concept capable of output potentials as high as 28 volts has been investigated. Technologies required for this module design have been developed beyond the state-of-the-art. An advanced Al_2O_3 casting technique was developed for the fabrication of the key insulated tri-layer assembly. Arc suppression coatings have been developed for the prevention of voltage arcs in the module due to potentials above the ionization potential of cesium. Fabrication and assembly techniques necessary for the logical development of the high voltage module concept have also been investigated. Heat pipe designs capable of transferring the required thermal throughput for high voltage module concepts have also been investigated. (auth)

31535 (ORNL-4526, pp 96-100) EXPERIMENTAL EQUIPMENT AND NEW TECHNIQUES. (Oak Ridge National Lab., Tenn.).

ACCELERATORS — development and operation of ORNL Solid State Division
BULK SHIELDING FACILITY — fast flux irradiation facility
CASTING — description of arc, for high-purity metals
LEVEL INDICATORS — description of cryogenic-liquid
METALS — preparation of spheroids of, by spark machining
VANADIUM — casting of high-purity, facility for (D.L.C.)

31536 (Pi(NT)-170-112) OPERATIONAL BALANCE SHEET OF THE "CHOUCA FURNACES" FROM JUNE 30, 1968. Gros, D.; Sciers, P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 7 Aug 1968. 63p. (In French). (CONF-681039-4). Dep. CFSTI (U. S. Sales Only).

From Euratom Conference on Irradiation Equipment, Grenoble, France.

The results of 350,000 hrs of irradiation made in the Chouca furnaces are reported. These irradiation devices are first described in some detail. Some types of sample gates are also described. The operation of the Chouca irradiation devices is outlined. (J.S.R.)

31537 (STI/PUB-238) RADIATION SAFETY IN HOT FACILITIES. Proceedings Series. Proceedings of a Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France, 13-17 October 1969. (International Atomic Energy Agency, Vienna (Austria)). Mar 1970. 766p. (In several languages). (CONF-691008). IAEA $21.00.

Fifty-nine papers were presented at the conference. Separate abstracts were prepared for 43. Sixteen were previously abstracted in NSA. For abstracts of these see CONF-691008 in the Report No. Index. (L.C.L.)

For abstracts of individual papers see: 31542-31567, 31597, 31598, and 31648-31662.

31538 (TEE-3874-8) PERFORMANCE OF A THERMIONIC CONVERTER WITH A NOMINAL SINGLE-CRYSTAL ⟨110⟩ TUNGSTEN EMITTER AND A NIOBIUM COLLECTOR. Lieb, D.; Donaker, A.; Rufeh, F. (Thermo Electron Corp., Waltham, Mass.). Dec. 1969. Contract AT(30-1)-3874. 72p. (TE-4122-84-70). Dep. CFSTI.

The performance of a variable-spacing converter with a specially-prepared ⟨110⟩ tungsten emitter and a niobium collector was recorded for the emitter temperature range of 1600 to 2000°K and an interelectrode spacing range of 0.5 to 40 mils. These data, though not from an exact ⟨110⟩ emitter, still show a higher output power than data from a chloride tungsten emitter. It appears that further increases in performance can be obtained by improving vapor deposition techniques. The work function of this niobium collector is in agreement with data from a molybdenum collector surrounded by niobium getters, and is higher by 0.1 eV than similar data from a molybdenum collector without niobium getters. (auth)

31539 (Y-DA-3318) SPRINKLER DEMONSTRATIONS AT THE OAK RIDGE Y-12 PLANT. McLaughlin, L. M. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 15 May 1970. Contract W-7405-eng-26. 30p. Dep. CFSTI.

The demonstrations described were conducted to observe the effects of applying water from a sprinkler fire fighting system onto materials generally considered too hazardous to be exposed. Materials tested consisted of powdered uranium metal, powdered uranium hydride, powdered lithium hydride, uranium and magnesium machine turnings, and a fused salt bath. These materials were tested both inside and outside a glove box. In the case of lithium hydride, experiments were also conducted to evaluate the use of nitrogen for purging hydrogen from the glove box to prevent the buildup of explosive mixtures. Nitrogen, argon, and Met-L-X were evaluated as to their effectiveness for smothering burning lithium hydride, uranium, and magnesium machine turnings inside a glove box. A demonstration was also conducted to evaluate a detergent-argon-water high-expansion foam as a fire fighting agent for burning metal inside a glove box. Auxiliary tests were made to determine if water from a typical sprinkler system impinging on empty metal containers could disturb a safe-geometry array; another test was conducted to determine if a pile of magnesium machine turnings would burn with sufficient intensity to actuate the 286°F sprinkler heads. One test was conducted to evaluate the damage to a glove box exposed to burning oil from an external source after the fire had actuated a typical sprinkler array. Results of the tests and demonstrations are presented. (J.R.D.)

31540 APPARATUS FOR LOCALIZED GAMMA IRRADIATION OF SMALL EXPERIMENTAL ANIMALS. Franchi, C. M.; Benech, C. R. (Instituto de Investigacion de Ciencias Biologicas, Montevideo). Arch. Soc. Biol. Montevideo; 27: Special No., 64-8(1969).

For localized γ-irradiation of small animals, a semi-portable ^{60}Co radiation unit was designed. Low cost, simplicity of construction, and safety of operations were predominant factors. Shielding of the source was designed for 100 Ci; however, the radiation produced amounted to only 38 Ci. The arrangement of shutter and collimators is described and results of radiation safety tests are given. (H.B.G.)

31541 PLASMA HEATED CENTRIFUGAL FURNACE OF ONE HUNDRED KILOWATTS FOR THE MELTING AND THE CASTING OF REFRACTORY PRODUCTS. Foex, Marc; Yerouchalmi, David; Delmas, Robert (Centre National de la Recherche Scientifique, Odeillo, France. Commissariat a l'Energie Atomique, Saclay, France). Compt. Rend., Ser. C; 270: 1082-4(23 Mar 1970). (In French).

A plasma heated centrifugal furnace for the melting and the casting of the refractory products is described. It makes it possible to melt ten kilograms of zirconia in a few minutes. (auth) (France)

31542 SAFETY FEATURES IN THE DESIGN OF THE RADIOLOGICAL LABORATORIES, TROMBAY. Mehta, S. K.; Krishnan, L. V. (Bhabha Atomic Research Centre, Trombay, India). pp 19-29 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The Radiological Laboratories of the Bhabha Atomic Research Center, located at the Trombay site, house the Metallurgy, Isotope, and Radiochemistry Divisions of the Center. The laboratories are designed to provide adequate facilities for metallurgical investigations of irradiated reactor fuels, for development and fabrication of plutonium fuel elements for the fast reactor program, for production of radioisotopes and for radiochemical investigations of compounds of uranium, thorium, plutonium, transuranic elements and fission products. The safety features in the laboratory design and operation are presented. The shielded cells and boxes, ventilation and filtration systems and fire protection and radiation monitoring systems are described. (auth)

31543 SAFETY PROBLEMS AND ASSOCIATED DESIGN FEATURES OF THE PROCESSED ISOTOPE PRODUCTION FACILITIES AT COMMERCIAL PRODUCTS, AECL, OTTAWA, CANADA. Waterfall, R. G. (Atomic Energy of Canada Ltd., Ottawa). pp 31-40 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The isotope production facilities at Commercial Products, AECL, Ottawa, are located in an urban area of high population density and have been in operation since 1954. Both sealed sources and processed isotopes are handled, but only facilities for the latter are reviewed. Processed isotope production rates have increased substantially over the years and typical annual production quantities of ^{131}I, ^{32}P and ^{197}Hg are now in the thousands of curies while hundreds of curies of ^{14}C, ^{203}Hg, ^{125}I and ^{51}Cr are also produced. Other isotopes are handled in smaller quantities. Some of the more interesting safety problems associated with the operation of the ^{32}P and ^{131}I production processes and three general purpose cells are described. Safety features are reviewed in the areas of target entry, solid and liquid waste removal, maintenance work and ventilation filter changing. Finally, a brief description is given of a facility which incorporates the features that Commercial Products' production experience has shown to be most desirable. The design combines high productivity, production flexibility, safety and low overall cost. (auth)

31544 PRINCIPLES AND METHODS OF PROTECTION ANALYSIS IN THE RISK EVALUATION OF A HIGH-ACTIVITY INSTALLATION. Ilari, O.; Nardelli, E.; Paribelli, S. (CNEN, Rome). pp 51-60 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

After considering the difference between nuclear safety and health protection with regard to meaning, interests and technical competence, the basic criteria for "protection analysis" of nuclear plants used in the licensing and inspection activities carried out by regulatory bodies are discussed. Such "protection analysis," particularly in Italy, is seen as an autonomous activity prepared in parallel with the safety analysis. In fact, the safety analysis is particularly concerned with the study of the design characteristics and operational conditions of a given plant with the aim of reaching an evaluation of the possible accidents and of defining the relative engineering safeguards, while the protection analysis is based on a broader and more comprehensive range of interdisciplinary knowledge, availing itself of advice from experts of different professional backgrounds such as health physicists, physicians, protection engineers, ecologists, etc. One of the basic points in protection analysis is risk evaluation, consisting of a detailed examination of the possible radiological consequences to the workers and the surrounding population from normal operation, malfunctioning, failures or accidents at the plant. The main aim of the analysis is to attain, when possible, a quantitative evaluation of the absorbed doses. Similarly, the quantitative evaluation of the environmental receptivity and of the critical pathways of radionuclides, especially in the food chains, is emphasized. Some examples of the protection analysis and of the risk evaluation for hot laboratories and reprocessing plants are discussed. (auth)

31545 SAFETY IN HOT LABORATORIES FOR THE STUDY OF FUEL REPROCESSING BY FLUORIDE VOLATILIZATION. Heremans, R.; Broothaerts, J.; De Coninck, A.; Hoeyberghs, H.; Lambiet, C.; Vandersteene, J. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 91-106 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

Within the framework of the joint research with Euratom on the reprocessing of ceramic fuels by volatilization of fluorides, the Center for Nuclear Studies at Mol has equipped a number of hot laboratories for pilot experiments on both irradiated and unirradiated fuels with a high plutonium content. The hot installations comprise a pilot laboratory for the study of volatilization and recovery of PuF_6, a pilot laboratory for study of the behavior of the various fission products during volatilization of UF_6, and a laboratory for the study of the kinetics of fuels with a high plutonium content and a high burn-up. The particular safety problems inherent in this type of installation are described in detail. They relate to the simultaneous use of highly corrosive and toxic products, such as fluorine, and highly concentrated fissile and radioactive elements. (auth)

31546 PREFABRICATED REINFORCED-CONCRETE ELEMENTS IN THE CONSTRUCTION OF HOT LABORATORIES. Huber, G. (Oesterreichische Studiengesellschaft fuer Atomenergie mbH, Seibersdorf, Austria). pp 153-60 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

To complete the construction of the hot laboratories at Seibersdorf as rapidly as possible, prefabricated elements were used for all buildings. The hot-cell wing was erected in three weeks, and the laboratory wing in another three weeks. The very smooth surface of these elements is important for decontamination of the interior after a nuclear incident. The joints between columns and the wall and roof elements were sealed with Thiokol cements to ensure a controlled atmosphere. The shielding of the pool in the hot-cell line was constructed of 3.5-ton barytes elements which can be removed if necessary. All joints were designed to prevent direct transmission. A short survey is given of the design and construction of recent hot-laboratory buildings in Austria, and, in addition, the general problem of installation ducts is discussed. In Seibersdorf special installation zones were designed for the laboratory wing, allowing horizontal and vertical duct access by a system of twin columns and architraves. The Seibersdorf hot-cell buildings may serve as an example of the value of modern building techniques in attaining quick results. (auth)

31547 DESIGN AND OPERATION OF MATERIAL TRANSFER SYSTEMS IN THE KFA HOT LABORATORIES. Mueller, H.; Stockschlaeder, F.; Witte, H. (Kernforschungsanlage, Juelich, Ger.). pp 193-200 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

Containment during transfer of radioactive materials in the KFA hot-cell facilities is achieved in a variety of ways. The HZ-1 cell bank of the HZ (Heisse Zellen) laboratory was originally equipped only with simple beta-type access doors and intercell transfer drawers. Each cell is provided with a "lazy susan," with which waste can be bagged out into a lead-shielded cell and loaded into a carrier. Additionally, in the door frames double covers have been installed by means of which a movable repair box can be fitted to the cell so that the joint is alpha tight. By another double-cover system, highly radioactive material can be loaded into a carrier and transferred into the HZ-2 cell bank inside the same building. This cell bank is equipped with strictly alpha-tight loading and unloading systems necessitated by reprocessing experiments where a relatively high level of alpha contamination has to be expected. More advanced designs are applied in the chemistry cells (Chemiezellen) now under construction and the BZL laboratory (Brennstoff-Zellenlabor). Here alpha-tight boxes behind gamma shielding are connected by an intercell conveyor system. For reloading highly radioactive materials, a transfer box is included in the box line. Outside the gamma shielding, a glove box is connected with the conveyor tunnel. The glove box is used for cold and low-activity transfers and also for maintenance of low-activity equipment. Monitoring data of typical transfer operations show that this design may successfully prevent the release of hazardous quantities of radionuclides and also overexposures to operating personnel. (auth)

31548 HANDLING PLUTONIUM-FILLED FUEL ELEMENTS. Bristow, H. A. S.; Tindale, J. B. (Atomic Weapons Research Establishment, Aldermaston, Eng.). pp 201-12 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design

and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

A facility for transporting fuel element cans between work stations where they are filled and the other stations where various other manufacturing operations are carried out is described. The philosophy upon which the design is based is discussed and the development outlined. The system selected transports fuel pins in both horizontal and vertical attitudes and is designed to accommodate various different shapes and sizes of fuel can. The work stations have individual containment linked to the transfer system to give maximum operating access but also to allow easy removal for process and equipment changes on maintenance. The design is such as to minimize exposure of operators to radiation. Mechanically, the system which is fully contained is simple and reliable and can be maintained without pressurized suit operation. The design has potential for upscaling and may eventually permit the replacement of full containment by small fume hoods. (auth)

31549 VEHICLE FOR TRANSPORTING AND SALVAGING RADIOACTIVE SUBSTANCES. Appelt, H. G. (Klotz GmbH, Grosskoetz, Ger.). pp 213-16 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The results of recent investigations indicate that the amount of radioactive wastes will be trebled within the next five years and will be eighty times as great by 1980 as a consequence of the increased production of nuclear energy. The question of modern and economical transportation and storage of radioactive material—especially of radioactive waste—is thus becoming more and more important. A vehicle for transporting and salvaging radioactive substances is described and discussed. The functional design of the vehicle is based on the laws of radiation: special protection for the operator is given by the distance separating him from the load transported. The essential shields for driver and operator can therefore be of thinner construction. Moreover, an extra shield can be fitted easily. Smooth surfaces and special paint facilitate cleaning the vehicle after each operation. All control handles are so constructed and placed that all unnecessary movement on the part of the operator is avoided. Consequently, there is less chance of error or fatigue. From his position the operator has a good view of the grabs. Further equipment can be added for especially difficult transport and salvage operations. For reasons of safety, only reliable and proven elements were used in the construction of the vehicle. It has already been tested and proven in difficult terrain and is considered to be extremely versatile. (auth)

31550 PROTECTIVE FACILITIES FOR PERSONNEL WORKING IN HOT LABORATORIES. Gorodinskii, S. M.; Shcherbakov, V. L. (Inst. of Biophysics, Moscow). pp 271-83 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

In order to design personal protective facilities for use in "hot" laboratories one must first specify the requirements to be met by such facilities and formulate a set of medical and technical standards relating to physiological changes in the organism of the wearer. On the basis of a variety of studies it is now possible to recommend standard indices relating to the efficiency of protective facilities, to the content in breathing mixtures of a number of human vital-activity products, and to the functional condition of the wearer. Protective facilities (pressurized suits, coveralls, respirators, etc.) which meet the recommended standards are produced in the Soviet Union. When contaminated, protective facilities can themselves become a secondary source of significant air and surface contamination in areas adjacent to "hot" cells; hence the need to combine the use of protective facilities with that of air locks incorporating changing rooms in which the protective facilities can undergo preliminary decontamination and personnel can be given preliminary medical examinations. An air lock of this kind and the use of air locks in combination with personal protective facilities are described in the paper. (auth)

31551 SEMI-AUTOMATIC SYSTEM FOR PERSONAL CONTAMINATION MONITORING. Muston, P. H.; Loosemore, W. R. (Atomic Energy Research Establishment, Harwell, Eng.). pp 285-96 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The system described has been shown to measure beta/gamma contamination on body surfaces, including feet, more consistently than hand-held scanning probes. It requires minimal co-operation from a user who has only to turn round for ten seconds on a plinth close to a vertical array of eleven GM-counters which have a nominal wall thickness of 40 mg/cm^2; a further counter is located in the plinth. The GM-counters are connected in four adjacent groups of three, with each group connected to a separate ratemeter and warning lamp to show the approximate location of the contamination. The ten-second measuring period is initiated automatically when the user interrupts a photoelectric proximity switch as he walks to the plinth. At the end of the period, an "all clear" chime sounds if no contamination is detected; buzzer and lamp indication is given of contamination above a preset level. Five preset sensitivity ranges enable the minimum detectable activity to be selected between 0.05 μ Ci and 3 μ Ci $^{90}Sr/^{90}Y$, spread over any area up to about 300 cm^2 at a distance of 10 cm, with automatic subtraction of background during a measuring period. The maximum permissible background on any range is chosen such that the probability of a spurious alarm is not greater than 0.1%; it varies with range from 25 μR/h to mR/h. A warning lamp shows when the background is above this maximum and operation of the monitor is then automatically inhibited. If due to a malfunction the output of any ratemeter falls to zero, a "fault" lamp lights and operation of the monitor is inhibited. Details of the system are described together with performance data for a wide range of operating conditions. (auth)

31552 PHYSIOLOGICAL ASPECTS OF RADIATION PROTECTION IN HOT LABORATORIES. Parkhomenko, G. M.; Kopaev, V. V. (Inst. of Biophysics, Moscow). pp 297-300 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The design and operation of "hot" laboratories involves a variety of problems regarding the radiation protection of personnel. Modern "hot" cells are properly equipped from the technical point of view for work with activities of 100,000 Ci or more. However, maximum avoidance of radiation hazards is possible only if one takes physiological factors into account. Study of the dosimetric characteristics of working conditions in "hot" laboratories has shown that operations performed directly inside "hot" cells entail the greatest radiation hazards to personnel. Functional changes in the central nervous system and the cardiovascular system, and distortions of various other functions, have been established in studies of the physiological state and fitness for work of personnel. Standard physiological indices for personnel are presented. On the basis of the results of the work which has been done it is possible to isolate and specify the basic physiological factors and to formulate requirements which must be met in the design of remote-handling equipment and in the arrangement of working areas in "hot" laboratories. (auth)

31553 CRITICALITY ALARM SYSTEMS USED AT THE EUROCHEMIC REPROCESSING PLANT. Hunzinger, W. (EUROCHEMIC, Mol, Belg.). pp 331-9 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

If there is a critical excursion of fissile material, the criticality alarm system will give an alarm in the endangered areas, thereby enabling rapid and safe evacuation of these areas to be carried out. Two different types of criticality alarm system are installed at EUROCHEMIC, the choice of type depending on local circumstances. One type of system detects neutrons from the excursion with a β-current detector connected to a dc amplifier. The entire system is designed according to the life-zero technique, electronically reliable with respect to both safe and unsafe failures. Its detection limit is 0.5×10^9 n/cm^2, and the response time is below 1 second. The other type of system is sensitive to γ-rays and employs ion chambers directly coupled to an electrostatic relay. The highly redundant system uses three ion chambers connected to a 2-out-of-3 matrix composed of electromagnetic relays. The detection limit is better than 50 mR. A built-in recharging circuit recharges all three ion chambers when the charge of one chamber has dropped by 20 mR, thus permitting the use of these criticality alarm systems independently of the γ-background radiation up to an exposure rate of 8 R/h. Its response time is better than 15 milliseconds. The designs of both types of criticality alarm system are given and the criteria on which the choice of type is based are discussed. (auth)

31554 CELLS ASSOCIATED WITH REACTORS: UNDERLYING CONCEPTS AND TRENDS IN THEIR DESIGN. Boulinier,

C.; Meunier, J.; Puychevrier, J. (CEN, Saclay, France). pp 387-95 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The design of hot cells or workshops associated with French reactors is dependent on the specific needs of the type of reactor concerned. For each type of reactor (research and irradiation, medium-capacity reactors of early design, and industrial power reactors), the advisability of attaching a hot cell or hot workshop is examined. The main purposes which such hot facilities can fulfill are described. The general concepts and principles underlying cells or workshops associated with reactors are then summarized in the conclusion. (auth)

31555 SAFETY ASPECTS IN REMOTE MANIPULATION OF RADIOACTIVE MATERIALS. PRACTICES AT THE RCN HOT-CELL FACILITY AT PETTEN. Wervers, H. J. (Reactor Centrum Nederland, Petten, Netherlands). pp 415-37 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The safety aspects of the RCN general-purpose remote-handling facility are discussed and a brief description of the facility is given as an introduction together with an analysis of the character of the typical operations. The safety aspects are considered in relation to the design of the facility and to an adequate system of instruction and procedures. Incidents are discussed and views given with respect to improvements which can be made at the facility. (auth)

31556 EQUIPMENT FOR THE EXTRACTION OF FISSION GASES FROM IRRADIATED NUCLEAR FUELS AND FOR THE PREPARATION OF FUEL SAMPLES FOR METALLOGRAPHICAL INVESTIGATIONS. Schuster, E.; Spang, A.; Hofmann, G. (Siemens-Schuckertwerke AG, Erlangen, Ger.). pp 439-44 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

Tested and proven equipment for the extraction of fission gases from irradiated fuel rods and for the embedding of samples for metallographical investigations is described. The gases are extracted by fitting a replaceable collar around any part of the fuel rod and perforating the cladding tube wall with a carbide-tip drill which works in a vacuum. The extraction equipment can be adjusted for the various cladding tube materials, rod diameters, surface features and fuel types. The equipment which embeds the fuel-rod sections for the metallographical investigations permits rods with spherical fuel particles to be impregnated and fuel samples in pellet form to be prepared for investigation. The simple method described can be used for closing all voids and cracks in the fuel that are recognizable under a microscope. (auth)

31557 OPERATIONAL EXPERIENCE WITH IN-CELL BOX SYSTEMS. Mueller, H.; Stockschlaeder, F.; Witte, H. (Kernforschungsanlage, Juelich, Ger.). pp 461-72 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The design of the BZL (Brennstoffzellenlabor) and HC (Heisse Chemie) hot laboratories of the Kernforschungsanlage Jülich is based on the concept of alpha-tight and exchangeable boxes placed behind gamma shielding. The BZL has been operating successfully for nearly three years. The HC is under construction and will be completed by the end of 1970. The above-mentioned concept has the advantages that contamination is localized on the exchangeable part of the system, that the contaminated surfaces are as small as possible and that maintenance of cell equipment can be done without using heavy protective clothing after removing either the box out of the cell enclosure or gamma sources out of the box. The complete in-cell box can be removed out of the gamma shielding without breaking the alpha containment and replaced by a spare box with new equipment which has been tested previously in a mock-up installation. The only disadvantage is the limited box volume. For transfer operations and in-box maintenance work, either beta-gamma or alpha-gamma techniques are used. To choose which of the techniques is more suitable, safety, efficiency and economy with each method have to be compared. Originally the extensive application of alpha-gamma techniques was envisaged on the basis of safety considerations. However, increasing operational experience in many cases permitted simpler procedures to be used without additional contamination risks. Uncontaminated or low-contaminated parts are only transferred into the box by a beta-gamma technique. On the other hand, for personnel entry into the boxes or extensive in-box maintenance work, the previously used beta-gamma lock-tent must be replaced in some cases by a special frogman carrier, which can be alpha-tightly fitted to the boxes. (auth)

31558 SAFE MECHANICAL DECLADDING IN FLOW-SHEET PROCESSING. Higgy, H. R.; Abdel-Rassoul, A. A. (Atomic Energy Establishment, Cairo). pp 473-9 of Radiation Safety in Hot Facilicilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

Safe mechanical decladding of nuclear fuel implies minimal particle contamination, simple working conditions and a limited need for maintenance operations. In the light of such considerations, each of the methods commonly used for mechanical decladding is subject to a number of limitations. Decladding by means of a shaving die causes buckling, as might be expected in the case of long and comparatively thin fuel elements. In decladding with an abrasion disc or milling cutter, considerable particle contamination is to be expected, since cutting into the fuel material can hardly be avoided. Quite recently, decladding by rolling-straightener has been the subject of increased investigation. Although the method seems to have wide applicability, it is of rather limited suitability for decladding non-metallic fuel materials (UO_2 and/or UO_2-ThO_2), where crushing the fuel may lead to considerable particle contamination. Decladding by a combined pressing-shearing technique is studied with a view to reducing the limitations of the method to a minimum. The main factors to be considered in the design of the machine are the dimensions of the fuel element and the thickness of the cladding and the fuel material. The cladding is slid onto the fuel mandrel by forcing the latter through a suitable die and the cladding material is emptied of fuel by shearing. The machine consists of a table on which the fuel element is fixed, a gear-reducer, and a special tool comprising a short plug attached to a cutting blade. The design data used are based on the Inchas Reactor fuel rod, which has 10% enriched fuel, aluminium cladding, 500 mm length, 10 mm outer diameter, and 1.5 mm cladding thickness. The bonding strength between fuel and cladding is 2750 kg. The method described is readily applicable for decladding with minimal particle contamination. The machine is easily operated (manually or mechanically) and little maintenance is needed. Procedures for flow-sheet test samples are discussed. (auth)

31559 DISMANTLING, DECONTAMINATION, AND NEW EQUIPMENT INSTALLATION IN THE METALLOGRAPHIC HOT CELL AT CSN CASACCIA. Cudia, B.; Giacarelli, R.; Lauro, M.; Minasi, R. (CNEN, Rome). pp 481-7 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The metallographic hot cell at the CSN Casaccia has been in operation since 1965. Recently, however, this cell was dismantled and decontaminated so that new and more reliable equipment could be installed. The new equipment for fast intervention into the cell and the safe transport of solid radioactive wastes were designed on the basis of previous experience with similar operations. Utilization of this equipment enabled the time required for dismantling, decontaminating and assembling the hot cell to be reduced to about a month instead of the three months required in the past. The spread of contamination in the surrounding areas was also reduced considerably. Because of the high contamination inside the cell, preliminary decontamination was conducted by means of master-slave manipulators; successful intervention with personnel has been performed by means of a box equipped with a tunnel suit and installed close to the back door. Depending on the contamination level, other plastic boxes have been built adjacent to each other to minimize progressively the spread of contamination. According to our experience, a more reliable and safe working method for in-cell intervention operations could be developed if isolation rooms were installed permanently in the loading area. (auth)

31560 SAFETY AND RADIOLOGICAL PROTECTION IN REPROCESSING PLANTS. Detilleux, E.; Hunzinger, W.; Cao, S. (EUROCHEMIC, Mol, Belg.). pp 489-96 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design

and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

In the design and operation of reprocessing plants, most of the problems relating to safety and radiation protection are encountered, since large amounts of radioactive and fissile materials in the form of unsealed sources are handled in these installations. Based on experience at EUROCHEMIC, the influence of protection requirements on the overall layout and the location of workshops and equipment is analyzed, and the solutions adopted for the prevention of criticality accidents and the elimination of the explosion risks inherent in the chemical process are discussed. The procedures adopted to ensure the protection of the operating personnel are then reviewed. In addition to the standard techniques employed at all radiochemical installations, these comprise collective control techniques for the accessible zones and individual techniques adapted to the control equipment selected and to determination of its conditions of use. An important factor is the administrative organization of safety measures, which must be based on close collaboration between the operators and the radiation protection services and on a clear definition of the respective responsibilities and duties. The organization set up at EUROCHEMIC is described in detail. Finally a critical analysis is presented of the experience accumulated during the first three years of operation, during which interventions have had to be made several times in hot cells. This critical analysis is aimed not only at defining the advantages of the preventive measures introduced in the design or in the course of operation, but also at suggesting further solutions in the light of the main difficulties encountered. (auth)

31561 NEW HOT-CELL FACILITY AT THE SEIBERSDORF REACTOR CENTRE. Patek, P. (Oesterreichische Studiengesellschaft fuer Atomenergie mbH, Seibersdorf, Austria). pp 529-34 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The new hot cells at the Seibersdorf Reactor Center were designed on the basis of experience acquired in the lead-shielded cells of the chemistry department. They will represent a hot-cell facility with adequate safety at low cost. The whole building, except the concrete shielding, is being constructed with prefabricated concrete parts. To maintain the necessary air pressure the leak-tightness of the building is increased by sealing all joints with Thiokol cements. The facility is specially designed for post-irradiation examinations of nuclear fuels, especially of coated particles for HTGRs, for inspection and control of research and power reactor fuel elements, and for the handling of high-level radiation sources. The facility therefore consists of six multi-purpose boxes, two special boxes for loading, unloading and storing of hot material and a pool. All boxes are alpha tight and shielded by 1-m barytes concrete walls lined with 8-mm thick steel frames. For the service penetrations into the alpha-tight boxes, new interchangeable connectors were designed, where locally limited contaminations collect. Safety is ensured by the adequate spare capacity of the ventilation system, which prevents contamination from spreading. This is particularly important when working with plutonium. The principle of adequate safety margins has also been applied to the transfer systems for inter-cell connections and the removal of solid waste. On the basis of our experience with lead-shielded cells, it is believed that the use of the plastic-bag technique avoids almost any contamination. For remote manipulation, handling, viewing and lighting systems, well proven types of equipment will be used. (auth)

31562 DESIGN OF A TRANSPLUTONIUM LABORATORY WITH A CIRCULAR ARRANGEMENT OF HOT CELLS. Shvetsov, I. K.; Kosyakov, V. N.; Morozov, D. V. (Inst. of Atomic Energy, Moscow). pp 535-45 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The design of a "hot" laboratory for research work on transplutonium elements is discussed. Some alternative versions of the general layout of the "hot" part of the building are examined and a circular arrangement of 12 "hot" cells is proposed as the optimum version. The layout selected is an improvement on the usual linear arrangement in that the building is more compact, the maintenance area is relatively small, etc. (auth)

31563 ORGANIZATION OF THE INTERVENTIONS ON HOT FACILITIES: MISHAPS, MAINTENANCE, DISMANTLING. Burch, W. D. (Oak Ridge National Lab., Tenn.). pp 559-66 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

Essential to the safety of all hot-cell facilities are the organization and planning for the handling of accidents and non-routine operations such as maintenance and dismantling. In addition to the important objective of protecting personnel and facilities, in these situations it is essential to minimize the effects of these interventions on normal operation of the facility. The proper handling of any such non-routine operations requires similar efforts in (1) careful preplanning, (2) well defined organizations and responsibilities, and (3) properly engineered designs. Generally, basic safety rules and regulations are standardized throughout any one laboratory, while the responsibility for the application of these rules is delegated to a group within a specific facility. The group directly responsible for all safety aspects of a hot-cell facility operation is usually the same group responsible for normal operations, although in some laboratories the responsibility rests in a separate safety organization. This latter approach appears to be less workable and provides no added safety. An important safety feature of all hot-cell facilities is the proper design of fail-safe systems such that only a minimum of direct action is required in an emergency. Instrumented fail-safe systems are preferable to reliance on personnel to react promptly and reliably in accident situations. Following an accident it is essential that thorough review be made and proper precautions taken to ensure against the repetition of this or a similar incident. Periodic reviewing of existing operations to ensure that original safety criteria are still being met is highly important. Gradual escalation of the scope over a number of years may lead to unsafe practices, although any one step in the escalation may have been insignificant. Safe maintenance practices which minimize interference with normal operations require (1) careful preplanning by technical designers, (2) adequate review by operating and health physics personnel, and (3) a well defined and understood formal work request-approval system with controls to ensure that equipment is properly shut down prior to the maintenance. (auth)

31564 RADIOLOGICAL PROTECTION DURING DECONTAMINATION OF A HIGH-ACTIVITY CELL LINE. Clayton, R. F. (Atomic Energy Research Establishment, Harwell, Eng.). pp 611-25 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

In 1966 the general purpose high-activity handling cell line at the Atomic Energy Research Establishment (AERE) became seriously contaminated by strontium-90 titanate powder, resulting in surface beta dose rates up to 10^5 rad/h. As the cell is used for a variety of experimental work and it is necessary to reduce cross-contamination between experiments to a minimum, the cells are periodically decontaminated. Although some cleaning is done remotely, for effective decontamination controlled entries into the cells are necessary. The operation described was unique because of the very high beta radiation dose rates present, unassociated with high levels of gamma radiation. Direct and indirect monitoring methods used to assess the amount of contamination and the associated dose rates showed that the risk of spreading surface and airborne contamination from opened cells was high, and that without strict control excessive radiation doses would be incurred by personnel. The spread of airborne and surface contamination was prevented by a system of controlled, tented and barriered areas, and by maintaining an atmospheric pressure differential between the cell interiors and the building operating areas. All persons entering the cells wore one-piece pressurized plastic suits. Excessive radiation exposure was prevented by strictly controlling working times in the cells and by periodic examination at predetermined times of "control" thermoluminescent dosimeters (TLD) worn by in-cell operators. To monitor the total doses received by various parts of the body each operator wore an array of 16 TLD and 5 radiation monitoring films inside his pressurized suit, and 10 "control" TLD and 2 quartz-fibre electroscopes outside the pressurized suit. The distribution of the doses over the body is reported. Approximately 450 cell entries were made by the 250 men employed in the operation. Only 18 men received doses marginally in excess of the relevant permitted 13-week dose; one of the finger doses exceeded the annual permitted dose. Bioassay showed that no one took a significant amount of radioactive material into his body. The operation demonstrated the necessity of wearing an array of dosimeters when working in high beta radiation fields, and the usefulness of TLD as a method of radiation exposure control. (auth)

31565 CENTRAL AIR-MONITORING SYSTEM FOR AN INDUSTRIAL RADIOCHEMICAL PLANT. Mueh, H.; Hemmerling, H.; Jung, D.; Schulze-Pillot, G. (Farbwerke Hoechst AG,

Frankfurt am Main). pp 675-80 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

A central air-monitoring system is described which surveys the airborne radioactivity at 20 different locations in a radiochemical plant. A probe has been developed to detect the activity of aerosols or gases which can be adsorbed on charcoal (such as iodine or mercury vapour). In selected locations throughout the laboratory a sample airstream is continuously withdrawn and fed through the probe which contains a 2-in. carbon filter paper. The activity retained is detected by a GM tube behind the filter. Background radiation is measured by a second GM tube. After amplifying and pulse shaping, the difference of the two pulse rates is transmitted to the central control board. The probe may be furnished with a NaI-crystal detector, so that monitoring of different nuclides can be done with a system of single-channel analyzers. Preliminary experience with the monitoring system and data on the retention of iodine and mercury vapor in the filter and on the behavior of the probe in a high background radiation field are presented. (auth)

31566 STUDY OF VENTILATION IN A LABORATORY FOR THE EXAMINATION OF IRRADIATED FUELS. Billard, F. (CEN, Fontenay-aux-Roses, France); Brion, J.; Cherel, G.; Abouaf, L. pp 681-94 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The ventilation of a laboratory in which there is radioactivity represents an important part of its cost, as regards both investment and running expenses. During the period of the year when heating is required, the air drawn into the building and subsequently expelled carries amounts of heat several times greater than the heat losses of the building. It is therefore interesting to examine the possibilities of reducing these costs. First of all a review is given of the role of ventilation. Two separate main functions are found: confinement and decontamination. Schematically, confinement is achieved by an open circuit which maintains adequate air flow rates, through the openings between areas, from the least exposed area to the area of maximum risk. It is easy to reduce the capacity of this circuit, which depends on the maximum possible surface of the opening between areas. The decontamination function can be effected by a closed circuit, i.e., by recycling air through cleaning devices. The amount of heat expelled to the outside atmosphere can thus be reduced. It should be remembered that decontamination must be sufficient to deal with frequent, but not very important, incidents, and not with major accidents which are unlikely to occur. These simple principles have been applied to the study of the ventilation of a laboratory for the examination of irradiated fuels constructed ten years ago. First of all, a study was made of the existing installation, its operation and its defects, and the prices have been discounted on the one hand on the basis of the original equipment, and on the other on the basis of present-day equipment. A new installation was then considered following the methods used for the design of the ventilation system of buildings planned in 1968, for which the requirements are less, taking into account the experience acquired in the last decade. The application of the main ideas described above led to the design of a third installation, the cost of which was evaluated. A comparison of these successive studies shows that: the improvement in the techniques and equipment alone results in a saving of almost 30% on investment; the simplification of the ventilation schemes and the reduction of the replacement rate to levels now considered appropriate lead to an additional savings of 40% on the installation cost and 53% on the heat losses to the stack; finally, the adoption of the principles described provides, in comparison with the 1968 type of installation, a saving of 10% on investment and a saving of 50% on heat losses to the stack, or an overall saving of 25%, capitalizing the heat losses over ten years. (auth)

31567 SELECTION OF A METHOD FOR IN-PLACE TESTING OF HIGH-EFFICIENCY FILTERS. Herrmann, G. (Technischer Ueberwachungs-Verein Hannover e.V., Hanover). pp 695-9 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The increasing production and use of radioactive material necessitates establishing standardized measures to ensure adequate confinement. High-efficiency filters are an effective means of confining radioactive material, but their trouble-free functioning should be ensured by testing them in-place before operational use. Different methods of testing individual high-efficiency filters are in use. The penetration measurements, which depend on the test aerosol, cannot, in general, be compared. A comparison can, however, be worked out by means of the phenomenological theory of filtration. The requirements for high-efficiency filters and filter installations cannot be specified in terms of the fraction of activity which may penetrate, but only relative to a certain test method. Such a method for testing filter installations at different facilities should have certain features: testing at high air flow rates, determination of efficiencies at least as high as those specified for individual filters, independence of the distribution function of the test aerosol, no sample processing, sufficient reproducibility. A test method with which the number distribution function is determined would have most of these features. (auth)

31568 SOLUTION OF THE AIR EXCHANGE PROBLEM IN THE WORKING CHAMBERS OF LARGE IRRADIATION PLANTS. Sobol, N. V. Kernenergie; 13: 55-7(Feb 1970). (In Russian).

A technique for calculating the air exchange in the working chambers of large irradiation plants (gamma irradiation rigs and electron accelerators) is proposed, based on taking into account the radiation effects in air. The "forbidden period" is calculated. (auth)

31569 SHIELD DESIGN FOR IRRADIATION PLANTS. Umeda, Iwao (Nippon Kokan K. K., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 163-5(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The design of concrete radiation shields for commercial irradiation facilities for sterilizing medical products and food irradiation is discussed. (L.C.L.)

31570 NEWLY CONSTRUCTED HOT-CAVES IN OSAKA UNIVERSITY. Kawanishi, Masaharu; Kikuchi, Riichi; Sawai, Tomikazu; Okumura, Masayuki; Okuma, Juzo; Kimura, Yoshitake; Nogaito, Takeshi; Owaki, Shigehiro; Iwama, Toshio (Osaka Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 166-8 (1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

When Osaka University moved to a new campus on the outskirts of the city of Osaka it was necessary to construct new hot laboratory facilities and to decontaminate the old facilities to ensure the radiological safety of future residential quarters on the old site. The important features of the new hot cells are described, and the decontamination procedures are discussed (L.C.L.)

31571 OUTLINE OF 35 KCi ^{60}Co IRRADIATION FACILITY OF GOVERNMENT INDUSTRIAL RESEARCH INSTITUTE, NAGOYA. Koshino, Masao; Imai, Hisao; Masuda, Hiroyuki; Kaminishi, Tokishi; Nunome, Keichi; Matsuda, Hideharu; Sakai, Yoshiro (Government Industrial Research Inst., Nagoya, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 169-71(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The design and operation of the 35 kCi ^{60}Co irradiation facility of the Government Industrial Research Institute at Nagoya, Japan are briefly described. (L.C.L.)

31572 DESIGN OF PRODUCTION FACILITIES OF THE RADIOISOTOPE PRODUCTION LABORATORY, JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. [PART] VIII. CELLS FOR PRODUCTION OF ^{32}P. Shibata, Nagao; Mochizuki, Tsutomu; Ito, Taro; Tachikawa, Katsuhiro; Yamabayashi, Hisamichi; Moki, Terutomi; Kobayashi, Katsutoshi; Okane, Shogo (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 172-4(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The design and operation of a new facility at the Radioisotopes Production Laboratory of the Japan Atomic Energy Research Institute for producing ^{32}P in 15 Ci batches are described. (L.C.L.)

31573 DESIGN OF PRODUCTION FACILITIES OF THE RADIOISOTOPE PRODUCTION LABORATORY, JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. [PART] IX. PRODUCTION FACILITY OF ^{131}I. Shibata, Nagao; Mochizuki, Tsutomu; Ito, Taro; Tachikawa, Katsuhiro; Iguchi, Akira; Onodera, Toshimi; Aoyama, Saburo; Izumo, Mishiroku; Sato, Akira (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 175-7(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The design and operation of a new facility at the Radioisotope Production Laboratory of the Japan Atomic Energy Research Institute for producing ^{131}I in 10 Ci batches are outlined. (L.C.L.)

31574 ENGINEERING TECHNOLOGY PRINCIPLES IN THE REPROCESSING OF NUCLEAR FUELS. Issel, Wolfgang (Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH, Leopoldshafen, Ger.). pp 55-69 of Der Nukleare Brennstoffkreislauf. Essen; Vulkan-Verlag Dr. W. Classen (1969). (In German).

From Meeting of House of Technology, Essen, Germany. See CONF-690338.

The nuclear engineering peculiarities in the reprocessing of nuclear fuels are outlined. The effects of certain nuclear properties on the design and construction of reprocessing plants are discussed. (J.S.R.)

31575 DESIGN AND OPERATION OF A 1370°C FORCED-CONVECTION LITHIUM CORROSION TEST LOOP. Huntley, W. R.; Clark, D. L.; Fleischer, B. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 6-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31576 MECHANICAL PROPERTIES OF STRUCTURAL MATERIALS FOR DESIGN EVALUATION OF PUMPS AND VALVES. Anderson, William F.; Kniley, Donald J. T. (Liquid Metal Engineering Center, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 121-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31577 ONCE-THROUGH STEAM GENERATORS WITH TWISTED TAPES. Brevi, R.; Cumo, M. (CNEN, Casaccia, Italy). Trans. Amer. Nucl. Soc.; 13: 339-40(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Heat Transfer and Fluid Flow

Refer also to abstracts 31533, 31534, and 33489.

31578 (BNWL-1367) INTERMEDIATE HEAT EXCHANGER MODELING FOR FFTF SIMULATION. Gunby, A. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT(45-1)-1830. 60p. Dep. CFSTI.

Several IHX modeling techniques were examined, using an example IHX design and example flow and temperature transients. For the purposes of FFTF system simulation (system thermal transients, control design, operator training), a mixed difference model (alternating central difference and three point-backward difference at each axial mesh point) was selected as the best single model. Model simplifications were investigated, resulting in a model with: (a) tube metal lumped with sodium, (b) constant metal and sodium properties, (c) four axial nodes, and (d) a single average heat transfer coefficient based on average coolant temperatures. (auth)

31579 (GEAP-13049) TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES: SUBCHANNEL AND PRESSURE DROP MEASUREMENTS IN A NINE-ROD BUNDLE FOR DIABATIC AND ADIABATIC CONDITIONS. Lahey, R. T. Jr.; Shiralkar, B. S.; Radcliffe, D. W. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar 1970. Contract AT(04-3)-189. 130p. Dep. CFSTI.

Extensive subchannel test data have been taken in an electrically heated nine-rod bundle under conditions typical of BWR operating conditions. Uniform and peaked local (radial) power distributions were run in order to determine the effect of the rod-peaking pattern on subchannel conditions. Analysis of the isokinetic and non-isokinetic subchannel data indicate that: (1) variation of flow and enthalpy within a rod bundle is quite pronounced; (2) current ventilated-subchannel codes, such as COBRA, do not accurately predict the trends in the data for two-phase conditions; (3) the crossflow enthalpy transferred during flow diversion is, in general, greater than the enthalpy of the donor subchannel and appears to be a strong function of flow regime; (4) the present data agree in general with previous adiabatic and diabatic subchannel data. In addition to subchannel data, pressure-drop measurements were made for single-phase and two-phase conditions. Analysis indicates that the single-phase friction factor is higher than the friction factor for a smooth tube and that the classical Martinelli-Nelson, two-phase friction multiplier ϕ^2_{Lo} correlates the data quite well. (auth)

31580 TURBULENT FLOWS IN LAYERS ADJOINING TO WALLS AND INSIDE PIPES. Millionshchikov, M. D. At. Energ. (USSR); 28: 207-20(Mar 1970). (In Russian).

Turbulent flow at the interface in tubes was studied previously by taking into account the principle of viscosity -molecular and turbulent superpositions. An attempt was made to confirm the results, by simplifying the hypothesis on the variations of mixed molecular and turbulent flow and calculating the flow in nonuniformly rough tubes. The method took into account the turbulent viscosity coefficient as related to certain parameters, e.g., the distance from the wall or the size of the projection of the roughness. The sum of the viscosity coefficients was resolved by superposition. The superposition method was applied not to the final results but to the coefficient of exchange. (R.V.J.)

31581 BOUNDS FOR THE VARIATIONAL RATIO OF ARBITRARY LINEAR SYSTEMS. Wilkins, J. Ernest Jr. (Howard Univ., Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 180-1 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31582 COMPUTER SIMULATION OF FLUID FLOWS USING EULERIAN DIFFERENCE METHODS. Gentry, Richard A. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 13: 182(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31583 THERMODYNAMIC NONEQUILIBRIUM IN TWO-PHASE FLOW. Petersen, E. N. (IBM Scientific Center, Palo Alto, Calif.). Trans. Amer. Nucl. Soc.; 12: 327(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31584 TWO-PHASE, HIGHLY DISPERSED FLOWS. Cumo, M.; Farello, G. E.; Ferrari, G. (CNEN, Casaccia, Italy). Trans. Amer. Nucl. Soc.; 13: 327-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31585 TWO-PHASE MODELING OF SODIUM BY WATER AND FREON. Khan, E. U. (Westinghouse Electric Corp., Madison, Pa.); Gouse, W. Trans. Amer. Nucl. Soc.; 13: 329-30 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31586 VIBRATION AND STABILITY OF TUBE EXPOSED TO PULSATING PARALLEL FLOW. Chen, S. S.; Rosenberg, G. S. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 335-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31587 AN APPARENT EFFECT OF HEAT FLUX UPON THE INCIPIENT POOL BOILING OF SODIUM. Singer, Ralph M. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 367-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31588 RADIATION EFFECTS ON SUPERHEATING OF LIQUID SODIUM. Deitrich, L. W. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 368-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Isotope Technology

Refer also to abstracts 31283, 31293, 31294, 31362-31364, 31420-31423, 31478, 31479, 31513, 31536, 31543, 31571-31573, 31577, 31649, 31678, 31743, 31763, 31808, 32355, 32356, 32364, 32365, 32416-32418, 32452, and 33078.

31589 (AI-AEC-12956) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE (LRHSC). Quarterly Progress Report No. 11, January-March 1970. (Atomics International, Canoga Park, Calif.). 8 May 1970. Contract AT(29-2)-2338. 86p. Dep. CFSTI.

Activities directed toward the development of technology for an isotope fuel capsule capable of operation in a space environment at a surface temperature of 2000°F or more for five (5) years or more are summarized. The work includes process, fabrication and test activities. The process and fabrication has included the work required to define an acceptable manufacturing specification for the reference design capsule and to manufacture the test items required for the program. The test program involves various coupons and capsules with evaluation of chemical compatibility, thermal cycling and adherence of coatings, capsule creep, capsule impact and capsule survival in potential abort environments. The data generated in this program will be used to validate design approaches and define design margins that would exist for high temperature capsules intended for flight systems. Information is in-

cluded on hardware design, fabrication and assembly; capsule creep testing; capsule impact testing; material compatibility testing; Transit capsule impact tests; Transit capsule fire tests; Transit capsule explosive overpressure tests; Transit capsule oxidation resistance; Transit capsule thermal verification; Transit capsule fragmentation tests; Transit-sized capsule fabrication and testing; and fabrication of Transit capsule piece parts. (J.R.D.)

31590 (BNWL–1309) PROMETHIUM ISOTOPIC POWER DATA SHEETS. Jarrett, J. H.; Van Tuyl, H. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT(45-1)-1830. 50p. Dep. CFSTI.

The nuclear, physical, mechanical, and chemical properties of promethium metal and promethium oxide are summarized. The projected availability of promethium is given and summary information on containment materials, together with summary information on promethium applications are included. (auth)

31591 (IAN-ARI–2) CALCULATIONS AND NOMOGRAMS FOR PRODUCTION OF RADIOISOTOPES IN REACTORS. Toro G., J.; Munera, H. A. (Instituto de Asuntos Nucleares, Bogota (Colombia)). 1969. 60p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

A series of cases of production of isotopes in reactors are presented in manual form. The deduction of the corresponding formulas, their simplification, and some practical examples of their use are given. The cases studied include: production of radioisotopes by (n,γ) reactions, taking into account and not taking into account the attrition of the target nuclide; production by (n,γ) reaction with subsequent β decay without considering the attrition of the target nuclide; analysis of the previous case by considering the cooling time; production by (n,γ) reaction and subsequent β decay considering the burn-up of the target nuclide; production of genetically related nuclear isomers by means of (n,γ) reactions; and simple (n,γ) reaction considering intermittent irradiation. (J.S.R.)

31592 (LA–4419) ^{238}Pu SPACE ELECTRIC POWER FUEL DEVELOPMENT PROGRAM. Quarterly Status Report, October 1–December 31, 1969. (Los Alamos Scientific Lab. N. Mex.). 6 Apr 1970. Contract W-7405-eng-36. 38p. Dep. CFSTI.

Continuing studies have demonstrated the capability of forming $^{238}PuO_2$ containing solid solution cermets (SSC). Work during the previous quarter was primarily oriented toward procuring and installing proper equipment and toward establishing a process which would produce SSC material of the specified composition and power densities. The short time scale did not allow any significant amount of process development. However, the process flow sheet employed does yield SSC fuel with the desired properties. Other studies have been in progress to characterize this fuel form and enough data have been obtained from these examinations to draw adequate conclusions as to its behavior and nature. The fabrication of such a $^{238}PuO_2$–ThO_2–Mo cermet in the specified form of a 2.14 in. dia disk was achieved during this quarter. A schematic representation of such a standard disc is shown. An outline and general description of the process was given previously. A status report on that process is given with appropriate illustrations wherever possible. (J.R.D.)

31593 (NUMEC–3731-20) RADIOISOTOPE POWERED CARDIAC PACEMAKER PROGRAM. COMPONENT DEVELOPMENT REPORT. VOLUME 1. PHASE I. VOLUME 2. COMPONENT DRAWINGS. VOLUME 3. FIXTURE DRAWINGS. (Nuclear Materials and Equipment Corp., Apollo, Pa. Energy Conversion Div.). 25 Mar 1970. Contract AT(30-1)-3731. 204p. Dep. CFSTI.

The results of component development work undertaken during Phase I of the Radioisotope Powered Cardiac Pacemaker Program are described. Phase I included development of microwatt technology, development of an improved radioisotope powered nuclear battery of long-term reliability, and performance studies of the necessary system integration. Details on the design, fabrication, and specifications for the various components, including the ^{238}Pu heat source, thermopile assembly, getter, outer case assembly, electronic circuitry and packaging, and the cardiac electrode, are presented. (L.C.L.)

31594 (ORNL–IIC–30(Pt.1)) SELECTED ABSTRACTS OF WORLD LITERATURE ON PRODUCTION AND INDUSTRIAL USES OF RADIOISOTOPES (FROM NSA, JANUARY–MARCH 1970). Gerrard, Martha; Baker, P. S. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 38p. Dep. CFSTI.

Approximately 340 abstracts of domestic and foreign publications on production and use of radioisotopes and radiation, selected from the January through March 1970 issues of Nuclear Science Abstracts, are presented. (auth)

31595 (WANL–543-1) ^{60}Co HEAT SOURCE DEMONSTRATION PROGRAM. PHASE I. PRELIMINARY ANALYSIS AND DESIGN TECHNICAL REPORT. Kim, C. (Westinghouse Electric Corp., Large, Pa. Astronuclear Lab.). Jan 1970. Contract AT(38-1)-543. 286p. Dep. CFSTI.

Activities in the Phase I Preliminary Analysis and Design effort on the Cobalt-60 Heat Source Demonstration Program for the period from March 1969 to December 1969 are summarized. The major objectives of the Phase I effort were to perform parametric analyses of factors influencing the heat source performance, versatility, scalability, size, weight, and cost to investigate the practicability of the out-of-hot-cell heat source operation, to develop preliminary design of the cobalt-60 heat source system, and to develop a conceptual design of the transportable refueling cask system. (auth)

31596 COMMENT ON LARGE SPACE STATION POWER SYSTEM. Ruehle, William G. (Aerojet-General Corp., Sacramento, Calif.). J. Spacecraft Rockets; 7: 639(May 1970).

It is noted that ^{60}Co and ^{238}Pu heat source weights are comparable in the multikilowatt power range. Results of studies indicate that the ^{60}Co kernel-type heat source can survive all hazards of use, and in addition its shorter half life removes the necessity of recovery after use. These and other aspects of the ^{60}Co kernel make it the leading contender for large radioisotopic electric power systems. (J.R.D.)

31597 SPECIFIC SAFETY PROBLEMS CONNECTED WITH WORK ON TRANSPLUTONIUM ELEMENTS AND SOME PRACTICAL SOLUTIONS TO THEM. Burch, W. D. (Oak Ridge National Lab., Tenn.). pp 61-75 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB–238; CONF-691008.

Special safety problems in the handling of the transplutonium elements have primarily two causes: the high specific alpha activity of most of the elements, and the neutron background created by spontaneous fissioning of ^{252}Cf and ^{244}Cm which may affect shielding design and the control measures for personnel exposure to penetrating radiation. Heating effects generally are significant only when massive quantities of curium are handled. In the USAEC Heavy Element Production program, hundreds of grams of curium and tens of milligrams of ^{252}Cf have been recovered at ORNL, in the Transuranium Processing Plant. Contamination is controlled and intake of activity by personnel held to very low levels by the proper functioning of well designed ventilation and transfer systems and through constant vigilance on the part of the operating and health physics groups in all handling operations. Work with any equipment or in areas contaminated to more than 5000 alpha counts/min per square decimetre requires masks; air suits are mandatory for levels greater than 10^6 counts/min per square decimeter. Transfers in and out of the cells are made with a double-door, mechanically sealed transfer case, which has been used for about 200 such transfers. Door seals are seldom contaminated to more than 5000 counts/min per square decimeter, and are easily decontaminated. Highly contaminated solid wastes are heat-sealed in 1½-mm-thick, 25-cm-diameter polyethylene buckets in a transfer station provided with a modified double-door transfer device. Neutron shielding is generally of special concretes with high water content. Carriers for shipping ^{252}Cf are massive; a carrier for transporting only 20 mg weighs ten tons. Neutron exposures to operating personnel are now quite low, but must be monitored in all operations. A special problem arises in alpha contamination checks with scintillation detectors. In a fast-neutron background of 10 mrem/h, approximately 100 counts/min per square decimeter are indicated on the alpha detectors. Insertion of a piece of paper between surface and detector filters out alpha particles, thus discriminating between neutrons and alpha contamination. On the other hand, any scintillation detector thus becomes a useful neutron survey meter. (auth)

31598 CONDITIONS FOR THE ESTABLISHMENT OF FACILITIES USING RADIOACTIVE SOURCES OUTSIDE NUCLEAR CENTRES. Chanteur, J.; Gardel, R.; Rebattet, C. F. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet, France). pp 341-54 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB–238; CONF-691008.

After reference to the French regulations governing the use of artificial radioisotopes outside nuclear centers, the main points of the rules for the establishment of facilities and the standards applied in France are presented. Details with reference to gamma

teletherapy facilities and those in which unsealed sources are used are given. The procedures for the disposal of solid, liquid and gaseous radioactive wastes from installations using unsealed sources are described. (auth)

31599 INVESTIGATION OF PROTACTINIUM AND URANIUM ACCUMULATION UNDER THERMAL NEUTRON IRRADIATION OF ^{230}Th AND ^{232}Th. Karalova, Z. K.; Palei, P. N.; Ivanov, R. N.; Gabeskiriya, V. Ya.; Pyzhova, Z. I. At. Energ. (USSR); 28: 199-201(Mar 1970). (In Russian).

Production of protactinium and uranium isotopes and burn up of thorium isotopes was determined during thermal neutron (1×10^{15} n/cm^2 sec) irradiation of preparations with isotopic ratio of ^{230}Th/^{232}Th = 1.462. Gamma and alpha spectra of protactinium and alpha spectra of the uranium–thorium fraction are given in graphic form. The results of calculations of effective cross section for radiative capture of ^{230}Th, ^{231}Pa, and ^{232}U showed 78.5 ± 12, 280, and 170 barns, respectively Data obtained were used for evaluating the production of ^{231}Pa for the given concentration of ^{230}Th as a function of the integral neutron flux. The maximum yield of ^{231}Pa for the thermal neutron density of 1×10^{15} n/cm^2 sec following 100 effective days was approximately 26%. (R.V.J.)

31600 BREMSSTRAHLUNG SOURCES FROM PROMETHIUM TUNGSTATE BASE. Weigel, F.; Scherer, V. (Univ., Munich. Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Radiochim. Acta; 13: 63-4(1970). (In German).

Promethium(III)-tungstate, $Pm_2(WO_4)_3$, and all Pm_2O_3–WO_3 mixed oxide phases emit the tungsten bremsstrahlung, which is excited by the ^{147}Pm 223 keV-β-radiation. The bremsstrahlung yield increases initially with increasing WO_3 concentration. When the WO_3 concentration is further increased beyond 10 moles WO_3 per mole Pm_2O_3, the yield levels off and approaches a saturation value. (auth)

31601 CALCULATION OF THE RADIATION FIELD OF A COLLIMATED GAMMA-RAY POINT SOURCE BY MOMENTS METHOD. Krueger, F. W. (VEB Kombinat Kraftwerksanlagenbau, Berlin). Kernenergie; 13: 47-54(Feb 1970). (In German)

The extent to which the moments method may be used for determining the radiation field of a collimated gamma point source is considered. For this purpose, a corresponding ZRA I routine was established. As the test case, the propagation of 1.28 MeV gamma radiation (^{60}Co) in water was calculated. The experience gained with this and the comparison of the radiation fields calculated with those calculated or determined experimentally by others show that the method proposed is also suitable for more extensive investigations. (auth)

31602 REPLY BY AUTHOR TO W. RUEHLER [ON LARGE SPACE STATION POWER SYSTEM]. Boretz, Jonathan E. (TRW Systems, Redondo Beach, Calif.). J. Spacecraft Rockets; 7: 639-40(May 1970).

Results of a review of ^{60}Co kernel concept for large power sources are presented. The review revealed that selection of this isotope as the leading candidate for such uses is premature. (J.R.D.)

31603 APPLICATION OF RADIOISOTOPES IN CONTINUOUS CASTING OF STEEL. Mori, H.; Matsuo, M.; Hirai, M.; Tanaka, N. (Yawata Iron and Steel Co., Ltd., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 113-15(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

An experiment in which ^{60}Co capsules and ^{198}Au wires were used as tracers in molten steel to determine the end point of solidification and rate of solidification in a continuous casting process is described. This solidification information can be used to improve the design and operation of the casting machine. A second experiment in which ^{198}Au wire was used as a tracer in the molten metal to determine the mean travel time of each metal strand in a multistrand casting machine is also discussed. (L.C.L.)

31604 MOLTEN POOL PHENOMENA IN THE SUBMERGED ARC WELDING. Mori, Naomichi; Horii, Yukihiko (Yawata Iron and Steel Co., Ltd., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 116-17(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Experiments were performed using ^{198}Au as a tracer to study the molten pool phenomena (molten pool shape, mode, velocity, and mixing of molten metal flow) and the behavior of the flux in high heat-input submerged arc welding. The results of the experiments are described. (L.C.L.)

31605 RADIOISOTOPIC GENERATOR. Ishimatsu, Kenji; Tabuchi, Hideho (Hitachi Central Research Lab., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 126-8(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Specifications for a small terrestrial ^{90}Sr-fueled thermoelectric generator and the design requirements for its radiation shielding are presented. (L.C.L.)

31606 ACTIVABLE TRACER STUDY OF DISTRIBUTION OF INSECTICIDE SPRAYED FROM A HELICOPTER. Kobayashi, M. (Japan Atomic Energy Research Inst., Tokyo); Enomoto, S.; Bando, S.; (and others). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 244-6(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The spray of agricultural insecticides on rice fields is generally accomplished by using helicopters, and the development of an economical spray technique which uses the minimum effective amount of insecticide and a minimum number of helicopter flights is desirable. A series of activable tracer experiments were performed to study insecticide distribution after spraying. Europium was used as the tracer, filter papers and rice leaf samples were irradiated in the nuclear reactor at JAERI, and the activation analysis performed. The results showed that the effective spray width for one flight is 40 m which is about half the width obtainable with a conventional spray machine, and that the degree of spray concentration decreases rapidly with distance from the flight centerline. Flights at 7 m altitude and 55.5 km/hr velocity showed the least spray loss. (L.C.L.)

31607 APPLICATION OF RADIOISOTOPES FOR DETECTION OF CHEMICAL REACTION. Furusawa, Takeshi; Yaguchi, Go. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 247-9(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Metal powders used in paint are produced by a crushing process. Stearic acid, introduced during crushing, has beneficial effects on the properties of powdered brass used in paints. These effects increase with aging and are the result of chemical reactions between the metal surfaces and the stearic acid. An experiment which used activation analysis and ^{64}Cu measurements to determine the relation between aging time and the quantities of copper stearate is described. (L.C.L.)

31608 RADIOISOTOPE PRODUCTION IN JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. Shibata, Nagao (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 492-6(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The achievements and output of the 5 yr (1963 to 1968) program on radioisotopes production at the Japan Atomic Energy Research Institute and the problems encountered in the program are summarized. (L.C.L.)

31609 PRODUCTION OF RADIOISOTOPE SOURCES IN AUSTRALIA. Engelbert, U. (Australian Atomic Energy Commission, Lucas Heights, New South Wales). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 497-508(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The history of Australian radioisotope production is briefly reviewed and a description is given of the criteria applied by the A.A.E.C. for local production. The prominent fields of production at Lucas Heights are short-lived processed radioisotopes and unprocessed radioisotopes of high specific activity which require high neutron fluxes. A brief review of distribution systems for these products in Australia and nearby areas is also given. (auth)

31610 ^{60}Co PRODUCTION IN THE BIG ROCK POINT POWER REACTOR. Haueter, Robert L. (Consumers Power Co., Jackson, Mich.); Ransohoff, Jackson A. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 509-15(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The commercial venture to produce ^{60}Co in the Big Rock Point Reactor at Jackson, Mich. is described. It is concluded that the ^{60}Co production has not interfered with power production and has provided an additional degree of flexibility in the operation of the fuel cycle-problems of post-irradiation shipment. Source recovery and calibration have been solved. The product has been introduced into normal commerce with considerable success in both research and production operations. The production of ^{60}Co has

been incorporated into the normal operation of the Big Rock Point fuel cycle. (auth)

31611 PRESENT STATUS AND FUTURE PROSPECT OF ^{60}Co SOURCES. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 739-57(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.
The present and future uses of ^{60}Co sources for agricultural and biological research, for medical purposes, in industry, and in large-scale irradiation processing are reviewed. (L.C.L.)

31612 PROBLEMS ON INDUSTRIAL USE OF ISOTOPES AND RADIATION. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 758-81(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.
Four committees organized by the Japan Atomic Industrial Forum analyzed the present status and problems in the uses of radioisotopes in four industrial fields: chemicals and fibers, iron and steel, civil engineering and construction, and radiation instrumentation. A brief outline of the results of these studies is presented. (L.C.L.)

31613 RESULTS AND EVALUATION OF INDUSTRIAL APPLICATION. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 782-800(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.
Five aspects of industrial uses of radioisotopes are briefly reviewed and include: methods for evaluating the economy of such uses, the use of ^{192}Ir in radiography, radiometric gages for measuring the sulfur content in fuel oils, and radioisotope applications in the aluminum industry and in engine wear studies. (L.C.L.)

31614 ANALYSIS OF A SUBLIMING NUCLEAR MICRO-THRUSTER. Choong, Philip T. (United Nuclear Corp., Elmsford, N. Y.); Mason, Edward A. Trans. Amer. Nucl. Soc.; 13: 16(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31615 DESIGN AND PERFORMANCE OF IMPROVED SNAP-19 RTG. Russo, F. A.; Buxbaum, R. S. (Teledyne Isotopes, Timonium, Md.). Trans. Amer. Nucl. Soc.; 13: 17(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31616 HIGH-TEMPERATURE, LOW-BALLISTIC INTACT IMPACT HEAT SOURCE (IIHS). Dick, P. J. (Teledyne Isotopes, Timonium, Md.). Trans. Amer. Nucl. Soc.; 13: 17-19 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31617 RTG FOR IMPROVED TRANSIT SATELLITE. Austin, G. E.; Stansel, J. C. (TRW Systems, Redondo Beach, Calif.). Trans. Amer. Nucl. Soc.; 13: 19(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31618 APPLICATION OF ISOTEC TECHNOLOGY TO THE TRANSIT RTG. Bradshaw, George B. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 19-20 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31619 OPTIMUM CONFIGURATIONS FOR REENTRY SAFETY OF 5- TO 50-W(th) RADIOISOTOPE HEATERS. Barsell, A. W.; Smith, T. H. (McDonnell Douglas Astronautics Co., Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 20-1(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31620 ISOTOPE HEAT SOURCE INTEGRATED WITH A 7-kW(e) BRAYTON CYCLE SPACE POWER SUPPLY. Ryan, Richard L. (AVCO-Systems Div., Wilmington, Mass.); Graham, John W.; Shure, Lloyd I. Trans. Amer. Nucl. Soc.; 13: 21-2 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31621 RADIOISOTOPE HEAT SOURCE DEVELOPMENTS. Botts, W. V. Jr. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 22-3(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31622 ^{252}Cf, A NEUTRON SOURCE FOR EDUCATIONAL PROGRAMS IN NUCLEAR ENGINEERING. Wiggins, P. F. (Naval Academy, Annapolis, Md.); Duffey, Dick; Senftle, F. E. Trans. Amer. Nucl. Soc.; 13: 27-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31623 DESIGN CONCEPTS FOR INTACT REENTRY OF RADIOISOTOPE HEAT SOURCES. McAlees, S. Jr. (Sandia Labs., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc.; 13: 50(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31624 REENTRY PROTECTION FOR RADIOISOTOPE HEAT SOURCES. Bramer, S. E.; Lurie, H.; Smith, T. H. (TRW Systems, Redondo Beach, Calif.). Trans. Amer. Nucl. Soc.; 13: 51-2(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31625 REENTRY PROTECTION MATERIALS SYSTEM (REPROM) FOR SPACE ISOTOPE HEAT SOURCES. Serkiz, A. W. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc.; 13: 53(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31626 FUEL FORMS FOR ^{238}Pu POWER SOURCES. Leary, J. A. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 13: 65(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31627 SELF-ABSORPTION IN TELETHERAPY AND IRRADIATOR ^{60}Co SOURCES. Chu, R. (Atomic Energy of Canada Ltd., Ottawa). Trans. Amer. Nucl. Soc.; 13: 70-1(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31628 CAPSULE MATERIALS FOR SPACE ISOTOPIC HEAT SOURCES; COMPROMISES BETWEEN CAPABILITIES AND REQUIREMENTS. Holland, J. R. (Sandia Labs., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc.; 13: 82(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31629 CALCULATION OF SURFACE GAMMA DOSE RATES FROM PLUTONIUM OXIDE SOURCES. Van Tuyl, H. H. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 95(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Materials Testing

Refer also to abstracts 31283, 31576, 32363, 32372, 32433, 32468, 32523, and 33075.

31630 (ANL-7555) NUMERICAL ALGORITHMS TO DETERMINE THE STRUCTURAL BEHAVIOR OF A CYLINDRICAL INVOLUTE FUEL PLATE UNDER STEADY-STATE LOADING. Taylor, D. B.; Marchertas, A. H. (Argonne National Lab., Ill.). Feb 1970. Contract W-31-109-eng-38. 41p. Dep. CFSTI.
Differential equations are derived describing the structural characteristics of a thin, cylindrical involute shell. The shell considered is of homogeneous construction and uniform in thickness, and is subject to a steady-state loading consisting of transverse pressure and internal thermal gradients. These are assumed to vary throughout the entire surface of the shell—in case of the temperature, also across the shell thickness. Boundary conditions are as follows: free involute ends of the shell; axial sides which are pinned, fixed, or what has been referred to as "rotated." In their final form, a total of three partial differential equations are deduced in terms of tangential, axial, and transverse displacements. These equations are not solved, but possible methods of numerical solutions are discussed. (auth)

31631 (BNWL-1321) THE APPLICATION OF IMAGE ENHANCEMENT TO FFTF FUEL TECHNOLOGY. Hayward, B. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT(45-1)-1830. 57p. Dep. CFSTI.
Current technical data analysis and evaluation methods are reviewed. Image enhancement is one of the advanced methods which is in the preliminary stages of application to nuclear technology. Interest in these systems lies in the extraction of more data from standard negatives than is presently obtained. Application of these

techniques to earth sciences, medicine, and space technology has already been demonstrated. Typical types of application to fuel work include x-rays, neutronradiographs, autoradiographs, electron diffraction patterns, and photomicrographs. (auth)

31632 HINTS FOR THE IRRADIATION PROTECTION AT MATERIALS TESTING USING X-RAY AND GAMMA RAY METHODS. Wuich, Walter. VDI (Ver. Deut. Ing.) Z.; 112: 535-40 (Apr 1970). (In German).

The increasing application of x-rays and gamma radiation in industry, especially in the field of materials testing, requires that personnel be taught the fundamentals and the demands of irradiation protection. The protective measures have to be in agreement with the legal requirements. A series of facilities, being important for the irradiation protection, are available which work on an optical and acoustical warning signal basis. (auth)

31633 COMPUTER SURVEY OF THE BEHAVIOUR OF TORISPHERICAL DRUM HEADS UNDER INTERNAL PRESSURE LOADING. PART II. THE ELASTIC-PLASTIC ANALYSIS. Crisp, R. J. (Central Electricity Generating Board, Berkeley, Eng.). Nucl. Eng. Design; 11: 477-94(Apr 1970).

A theoretical elastic-plastic analysis has been carried out on a large number of torispherical drum heads; the first yield pressure, maximum shake-down pressure and limit pressure have been obtained for each vessel. A method is put forward by which these results could be used to design torispherical drum heads and comparisons between these results and one of the current design codes of practice are included. (auth)

31634 SOME REVIEW OF THE RADIOGRAPHIC TESTING IN JAPAN IN 1968. Isshiki, Sadabumi (Tokyo Univ.). Hihakai Kensa; 18: 391-3(Sep 1969). (In Japanese).

Activity in regard to radiographic testing in 1968 is briefly reviewed. The radiographic testing method for metallic material and the welds of steel and aluminum, and the standards for industrial x-ray film were established. The production of ^{192}Ir for a radiographic device began in Japan and was put on the market. In the photographing with high energy radiation, after the irradiation and radioactivation of metal plate in place of film, the transcription from the metal plate to film was tried. Color autoradiography has been developed. Many test researches with ^{192}Ir as a radiation source in place of the usual x-ray or ^{60}Co sources were carried out. As the automation of the nondestructive test of welds has been requested in all fields of industry, an automatic measurement system of radiographs was devised, but it still has some difficulty with regard to cost and accuracy. In order to get clear radiographs, the theory of photography was reconsidered and an idea to remove scattering radiation was adopted. In the test of radiation quality, the effective energy of ^{192}Ir radiation source and the bremsstrahlung of ^{170}Tm were also investigated. Furthermore, as for high energy x rays, the effective absorption coefficient of iron and the attenuation by various materials are reported. (NSA of Japan)

31635 IMAGE QUALITY IN RADIOGRAPHY. Evrard, M.; Dubresson (CCRS, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); Suppl. No. 78, 17-26(Jul-Aug 1969). (In French).

Work which led to the recommendation of two types of image quality indicators is reviewed, and the results reported which resulted in propositions concerning the image quality values which can be used on steel for given conditions of radiography. The different sources of radiation (x or γ) are classed in an identical manner and it should be taken into consideration in order to appreciate the results of a radiographic examination. Moreover, the correspondence between the image qualities determined from different types of image quality indicators is discussed and the consequences of drawing on them for the establishment of charge records or of specifications are exposed. In particular, it is shown that the need, often encountered in practice, of a sensitivity expressed in percentage of the thickness has validity only if the type of image quality indicator is clearly defined. For the establishment of image quality curves as a function of the thickness it is possible to obtain continuous curves, in spite of the use of stepped devices, on the condition of choosing judiciously the thickness limits to be considered in each case. (tr-auth)

31636 DIMENSIONAL MEASUREMENTS OF CYLINDRICAL SPECIMENS USING NEUTRON RADIOGRAPHY. Basham, S. J.; Grieser, D. R.; Ray, J. W. (Columbus Labs., Ohio). Mater. Eval.; 28: 140-4(Jun 1970).

Many applications of neutron radiography involve dimensional determinations on the specimen being examined. This is particularly difficult for cylindrical specimens because specimen thickness, and hence the optical density of the radiograph negative, changes continuously with position along the specimen diameter. A technique was developed which involves scanning the neutron radiographic negative with a traveling microdensitometer and recording the densitometer output on a strip chart recorder. The shape and dimension of the recorder trace is related mathematically to specimen diameter, taking into account specimen geometry (cylindrical) and total macroscopic neutron cross section of the specimens. This technique is capable of very precise dimensional determinations. (auth)

31637 COMPUTER SURVEY OF THE BEHAVIOUR OF TORISPHERICAL DRUM HEADS UNDER INTERNAL PRESSURE LOADING. PART I. THE ELASTIC ANALYSIS. Crisp, R. J. (General Electricity Generating Board, Berkeley, Eng.). Nucl. Eng. Design; 11: 457-76(Apr 1970).

The elastic stress distributions in a large number of torispherical drum heads have been analyzed using a digital computer program. The peak stress concentration factors in various sections of the head and drum have been presented in graphic form as functions of the head shape parameters. A correction for the nonlinear stress gradients through the shell thickness in small radius knuckles has been included. (auth)

31638 HIGH INTEGRITY TRACE HEATING FOR SODIUM PROCESS PIPING. Kimont, E. L.; Bohne, L.; Smith, F. A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 97-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Protective Structures

Refer also to abstracts 32886 and 32887.

Radioactive Material Handling

Refer also to abstracts 31472, 31476, 31487, 31542, 31545, 31547, 31549, 31550, 31552, 31554-31559, 31561-31564, 31598, and 31973.

31639 (BNWL-SA-2686) DATA ACQUISITION FOR FUEL FABRICATION. DeMerschman, A. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 20 Nov 1969. Contract AT(45-1)-1830. 7p. (CONF-691102-23). Dep. CFSTI.

From 17th Conference on Remote Systems Technology, San Francisco, Calif.

Installation of an SEL 1018B data acquisition system for inventory and criticality control of enriched fissile materials at the Fast Flux Test Facility is reported. The system provides a data storage and rapid retrieval capability for process use and quality control. (J.R.D.)

31640 (DPSPU-68-124-2) SAFETY SUMMARY REPORT: CURIUM SHIPPING CASK (PACKAGING OF RADIOACTIVE AND FISSILE MATERIALS). Kelsch, R. D.; Wilkins, C. A. (comps.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Sayannah River Plant). Apr 1968. Contract AT(07-2)-1. 47p. Dep. CFSTI.

Curium oxide shipped in a shielded cask as described in this report, complies with AEC Manual, Chapter 0529 (AECM 0529), Safety Standards for the Packaging of Radioactive and Fissile Materials. The shipping cask withstands normal and accident conditions of transport without the release of any curium oxide. (auth)

31641 (GA-9871) APPLICATION OF PHOTOINDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS. Quarterly Progress Report, July 1, 1969-September 30, 1969. Bramblett, R. L.; Ginaven, R. O.; Gozani, T.; Kull, L. A.; McMillan, J. I.; Reynolds, G. M.; Rundquist, D. E. (Gulf General Atomic, Inc., San Diego, Calif.). 28 Nov 1969. Contract AT(04-3)-167. 58p. Dep. CFSTI.

Developments in equipment and techniques for the nondestrictive assay of nuclear materials are summarized. The projects described include barrel assay, a digital computer system, a linac sub-MeV neutron technique, threshold photoneutron measurements, a computer code for the analysis of γ-ray spectra, energy calibration and resolution determination for the 270° magnet system, a transportable assay system, and scanner system x-ray shielding. (J.W.R.)

31642 (GA-9943) APPLICATION OF PHOTOINDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS. Quarterly Progress Report, October 1-December 31, 1969. Bramblett, R. L.; Ginaven, R. O.; Gozani, T.; McMillan, J. I.; Reynolds, G. M.; Rundquist, D. E. (Gulf General Atomic, Inc.,

San Diego, Calif.). 30 Jan 1970. Contract AT(04-3)-167. 46p. Dep. CFSTI.

The development of nondestructive measurement techniques for nuclear materials in the various forms encountered in the nuclear reactor fuel cycle are summarized. Aspects of the program on which significant progress was made during the reporting period are described. The projects include the low sub-MeV Neutron Technique; barrel scanning-data analysis; threshold photoneutrons from ^{235}U; fission product gamma spectra for ^{235}U, ^{239}Pu, ^{232}Th, and ^{238}U; neutron yield calculations; and a transportable assay system. (R.C.K.)

31643 (GA-10106) APPLICATION OF PHOTOINDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS. Quarterly Progress Report, January 1–March 31, 1970. Bramblett, R. L.; Ginaven, R. O.; Gozani, T.; Trimble, G. D.; Rundquist, D. E. (Gulf General Atomic, Inc., San Diego, Calif.). Contract AT(04-3)-167. 41p. Dep. CFSTI.

The development of nondestructive methods and equipment for measurement of nuclear materials in the various forms encountered in the nuclear reactor fuel cycle are summarized. The methods and equipment being developed are oriented toward those which use electron accelerators for the interrogating source. Progress is reported on the construction of a transportable assay system for nuclear materials in bulk samples; barrel scanning; the timing sub-MeV assay method. Information is also presented on photoinduced neutron yields and fission product gamma-ray yields. (R.C.K.)

31644 (STI/DOC-10/101) STANDARDIZATION OF RADIOACTIVE WASTE CATEGORIES. Technical Reports Series No. 101. Report of a Panel held in Vienna, 6–10 November 1967. (International Atomic Energy Agency, Vienna (Austria)). 1970. 18p. IAEA $1.00. Dep.

In order to develop more uniform international standards for the classification of radioactive wastes, the present state of waste classification is reviewed, and proposals are made for defining specific categories of gaseous, liquid, and solid wastes. The categories are based on the radioactivity concentration for liquid wastes, the radiation dose on the surface of the waste for solid wastes, and the radioisotope content of gaseous wastes. (L.C.L.)

31645 (UCRL-50850) REPAIRING A LARGE TRITIUM-CONTAMINATED SYSTEM. Folkers, C. L.; Johnson, K. A. (California Univ., Livermore. Lawrence Radiation Lab.). 9 Apr 1970. 6p. Dep. CFSTI.

A process was developed to permit major repairs on a large dry box and gas purification system which were highly contaminated with tritium. The process was based upon a portable flush hood attached over the work area and a high-velocity air flow to minimize airborne contamination. Radiation exposures of the personnel involved were all well within acceptable limits. (auth)

31646 (Y-DR-17) LIMITING CRITICAL CONCENTRATIONS OF PLUTONIUM–URANIUM SOLUTIONS AND MIXTURES. Magnuson, D. W. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 20 May 1969. Contract W-7405-eng-26. 5p. Dep. CFSTI.

Calculations using the ANISN transport code were performed in the S_4 approximation using the Hansen–Roach cross-section sets appropriate to the scattering cross section per atom for the U and Pu isotopes for the limiting critical concentrations for various plutonium–uranium fuels at several H:U atom ratios. The results of these calculations are summarized tabularly. (J.R.D.)

31647 INCINERATORS FOR INFLAMMABLE RADIOACTIVE WASTES. I. Kadoya, Shozo; Muramatsu, Takio (Ebara Mfg. Co. Ltd., Tokyo). FAPIG (Tokyo); No. 51, 196-200(Nov 1968). (In Japanese).

An experimental incinerator and then a practical one were constructed for use in Japan Atomic Energy Research Institute. The experimental incinerator, with the capacity of 10 kg/hr, for burning inflammable wastes including paper, cloth, plastic, etc., and animal carcasses is described. The incinerator was constructed to test its practicability, to learn burning techniques, and to test incinerator materials. In this connection, the behavior of the radioactivity of wastes was studied with ^{32}P as a tracer, and also the decontamination factors for various operating conditions were obtained. The incinerator plant consists of a furnace, scrubber, cooler, electric dust catcher, filter, and blower. The furnace is designed to operate at 1,000°C, and for burning wet objects, an auxiliary burner is provided. (NSA of Japan)

31648 PILOT PLANT FOR TREATMENT OF RADIOACTIVE WASTE FROM THE IEN HOT LABORATORY. dos Santos, Lydia (Instituto de Engenharia Nuclear, Rio de Janeiro). pp 41-9 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

A preliminary design for a pilot plant for the treatment of low- and medium-activity liquid wastes from the IEN (Instituto de Engenharia Nuclear) hot laboratory and from the MTR high-flux reactor currently under construction is described. The low-activity wastes will be decontaminated by a precipitation, clarification and ion-exchange process. Medium-activity waste will be concentrated by evaporation and incorporated in bitumen. (auth)

31649 SPECIFIC SAFETY PROBLEMS IN WORK WITH TRANSPLUTONIC ELEMENTS. Kosyakov, V. N. (Inst. of Atomic Energy, Moscow). pp 77-88 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The specific aspects of work with transplutonic elements are discussed. This specificity is primarily connected with the fact that intense sources of alpha radiation are involved in such work, representing a serious hazard with respect to contamination of the air of working areas and their environment. This means that additional and stricter demands are made on the design of the protective devices used (largely from the point of view of hermetic sealing and the technique of carrying out operations) and on the efficiency of air cleaning before venting to the atmosphere. A second aspect of work on transplutonic elements is the need for neutron shielding. The reason for this is that some isotopes, such as curium-242 and 244 and californium-252, undergo spontaneous fission and are sources of fast neutrons. In addition, following interaction with light nuclei, intense sources of alpha radiation can become sources of neutrons by the (α,n) reaction. The need for neutron shielding entails the use of specific materials for the biological shielding of the cells and boxes and a special observation system. A review is given of design measures taken to meet the radiation protection requirements. An attempt is made to assess the maximum amount of transplutonic elements, work which requires only a certain degree of conversion of normal "hot" laboratories, and the amounts which would require the construction of special "hot" laboratories. (auth)

31650 SAFETY ASPECTS OF WASTE MANAGEMENT AND THE DECONTAMINATION FACILITIES AT A NUCLEAR FUEL REPROCESSING PLANT. Maruyama, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Nakajima, K.; Nishiwaki, Y. pp 107-26 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The reprocessing plant in Japan and the possible effects on the environment from the health physics standpoint of disposal into the sea of the liquid wastes are described. The reprocessing plant is to be fire- and earthquake-proof and is designed to assure not only safety under normal operational conditions but also safety to the public in the event of a credible accident. Of the various radioactive wastes, those with a high level of radioactivity will be stored semi-permanently in the plant or in a controlled area. The gaseous and liquid wastes will be released to the environment after treatment at the waste management facilities. The gaseous waste will be released to the atmosphere from the 90-m stack. The low-level liquid waste will be disposed of into the bottom of the sea in the Pacific 1 km off shore. The treatment capacity of the plant is 0.7 t/d for natural or low enriched uranium. When the low enriched uranium fuel is treated at the maximum capacity of the plant, the ^{85}Kr in the gaseous waste is expected to be about 8000 Ci/d, but the maximum annual exposure of the public in the neighborhood will be about 30 mRem/yr. The radioactivity in the liquid waste is about 0.7 Ci/d on an average. The effects on the public in the environs due to the consumption of marine foods may be estimated, at the maximum, to be about 2 mRem/yr for the whole body, and about 50 mRem/yr for the gastrointestinal tract, which are well below the values recommended by ICRP. (auth)

31651 SAFETY MEASURES AND WASTE MANAGEMENT SYSTEMS AT THE HUNGARIAN ISOTOPE PRODUCTION PLANT. Hirling, J. (Inst. of Isotopes, Budapest). pp 139-50 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The Hungarian Isotope Production Plant (IPP) started operation three years ago. The cells where the isotope products are prepared are divided into two separate lines, depending on whether the products are for medical or general use. The IPP was completed with special waste management systems for both solid and liquid radioactive wastes. A special infra-red-heated evaporator combined with a cement solidification method was also developed. Much care was taken with the ventilation and the air-cleaning systems of the facility. Comprehensive studies were carried out to develop various air filter bags, including packaging for removal of radioiodines. Some supplementary data are given on the methods of calculating air filtration. (auth)

31652 RELEASE EXPERIMENTS ILLUSTRATING THE RISKS OF HANDLING IRRADIATED PLUTONIUM FUEL IN BETA-GAMMA CELLS. Andersson, V.; Nordlund, H. (Aktiebolaget Atomenergie, Studsvik, Sweden). pp 225-34 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The hot cells at the metallurgical laboratory at Studsvik, Sweden, were built in 1959-1960 and were originally designed for up to 1 MCi of 1-MeV gamma activities. Normally there is an underpressure of 30 mm of water in the cells, but they are by no means as tight as glove boxes for alpha activities. New reactor fuels enriched with plutonium have advanced the idea of also using the hot cells for the examination of irradiated plutonium fuel samples. Experiments have therefore been carried out by crushing irradiated uranium dioxide fuel in the cells. After airborne dust had been created, the ventilation was stopped for up to two hours and air samples were taken from the cells and from the operating area. Besides activity analysis, the particle-size distribution of the aerosol was studied. The experiments show that if 80 g of uranium dioxide (~60 Ci mixed fission products) is crushed in the cell, a volume concentration of less than 4×10^{-8} Ci/m^3 of air is obtained in the operating area. This is less than 1% of the concentration in the cell at the same time. Eighty-five percent of the aerosol activity released was borne by particles less than 5 μm in diameter. If it were assumed that plutonium fuel would behave in a similar manner, 80 g of ^{239}Pu crushed in the cell would give 3×10^{-9} Ci/m^3 in the operating area when the ventilation was stopped. With plutonium in insoluble form, this is equivalent to 75 mpc_{a40}. If the plutonium were irradiated to 3000 MWd/t, 80 g would correspond to 125 mpc_{a40} in the operating area. The surface contamination would be $\sim 6 \times 10^{-5}$ μCi/cm^2. Crushing fuel samples is the most dust-producing type of in-cell work. If, therefore, the hall were evacuated a few minutes after a fan stop, the dose commitment from internal contamination would have to be much less than the permissible dose for one week. Therefore it is believed that, with minor changes in the laboratory, such as a special box for manipulator services and airlock arrangements in the loading area, it is also possible to use these cells for the examination of irradiated plutonium fuel. (auth)

31653 PERSONNEL PROTECTION IN HOT FACILITIES. Soman, S. D. (Bhabha Atomic Research Centre, Trombay, India). pp 257-69 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

Four important phases of personnel protection in hot facilities, namely training of personnel, operational safety measures, and surveillance and monitoring, are discussed. The built-in provisions and the operational surveys are outlined for controlling external exposures, contamination, and inhalation hazards to the workers. The tests, both pre-operational and during operations, that are performed on the effectiveness of these measures are described. Final indications of this effectiveness are given by the results of the surveillance and monitoring program and especially by the records of personnel exposures. A summary of these data over the past five years is given for the BARC. (auth)

31654 RADIATION AND CONTAMINATION MONITORING IN THE KFA HOT LABORATORIES AT JUELICH. Buch, R. (Kernforschungsanlage, Juelich, Ger.). pp 301-10 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

Taking hot cells, fuel cells, and chemistry cells as an example, the criteria which have governed the choice of radiation protection instrumentation are listed and the tests carried out with these are described. In particular the feasibility of using atmospheric pollution and contamination monitors are examined. Personnel monitoring methods are discussed. (auth)

31655 REMOTE RADIOMETRIC CONTROL OF IRRADIATED MATERIALS AND TECHNOLOGICAL PROCESSES IN HOT CELLS. Kondakov, N. D. (Research Inst. of Atomic Reactors, Melekess, USSR). pp 311-17 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The hot-cell equipment used for remote monitoring of the distribution of radioactive elements along irradiated targets is described. The equipment comprises spectrometric and neutron scanning devices. For the control of technological processes a flow counter is used to measure alpha activity and another device measures the gamma activity of solutions directly in "hot" cells. (auth)

31656 DECONTAMINATION AND REHABILITATION OF HIGHLY ACTIVE CHEMICAL PLANT AND CAVES. Broadley, J. S. (Dounreay Experimental Reactor Establishment, Thurso, Scotland). pp 357-66 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

At Dounreay Experimental Reactor Establishment highly active chemical plants and examination caves have been in operation for a number of years. The plants were designed for reprocessing MTR, U-Al alloy, and DFR, U-Mo alloy, fuels, and they deal routinely with fuel handling at the kilocurie level and have specific activities of up to 2 Ci/ml in feed solutions. In general the plants were designed so that the highly active sections would be trouble-free, but over the years changing requirements and the occasional mishap have made it necessary to enter and modify equipment. The experience gained during these operations has led to a better knowledge of methods of decontamination, design of facilities to allow maintenance, and the general management of planned irradiation exposures. The actual operations carried out at the Dounreay Experimental Reactor Establishment, giving details of the methods used and discussing how the experience gained can be used to make future facilities more suitable for remote maintenance, are described. (auth)

31657 THREE YEARS OF EXPERIENCE IN THE HANDLING OF IRRADIATED PLUTONIUM, AMERICIUM, AND CURIUM. Samsel, G.; Vaane, J.; de Ras, E. (EURATOM, Karlsruhe, Ger.). pp 497-509 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In French).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB-238; CONF-691008.

The hot laboratory of the Institut européen des transuraniens has been in operation since the end of 1966. In its cells extremely varied examination work has been carried out in connection with fuel elements for thermal reactors, experimental elements for fast reactors, irradiation capsules, and large quantities of irradiated transplutonium elements, such as americium and curium. During these three years of operation, culminating in the fabrication of an isotope battery with the handling of 1 g of ^{242}Cm, no serious incident has occurred in the laboratory. However, although during this period certain basic design features selected when the laboratory was constructed have proven entirely satisfactory, others have been modified so as to adapt them fully to the requirements of operation and safety. In this connection the characteristic facilities of the laboratory, namely the $\alpha\beta\gamma$ cells, the bootings of the direct manipulators, the ventilation systems of the cells, the fire protection systems, and the contamination detection systems, are reviewed and submitted to a critical examination. The conclusions which can be drawn at the end of this first phase of operation are on the whole positive, which must be attributed both to technical measures, of which the most important are the use of bootings in the cells with high alpha contamination and with an extremely corrosive atmosphere, and the double-cover systems for operations in medium-activity cells, and also to co-ordination between those responsible for the construction, operation and safety of the laboratory. (auth)

31658 OPERATING EXPERIENCE ON AN ECONOMICAL ^{238}Pu PROCESSING FACILITY. Shupe, M. W.; Mullins, L. J.; Morgan, A. N.; Gonzales, A. L.; Ogard, A. E.; Valentine, A. M.; Leary, J. A. (Los Alamos Scientific Lab., N. Mex.). pp 511-22 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB–238; CONF-691008.

Plutonium-238 is an important radioisotopic heat source for space and biomedical applications. Since 1967, the Los Alamos Scientific Laboratory has been operating a ^{238}Pu processing facility. Conventional ^{238}Pu processes have been conducted in this facility on a 100-g ^{238}Pu scale. The processes include purification in aqueous media, metal preparation, electrorefining, metal casting, oxide and nitride pelleting and sintering, and encapsulation of sources. The processes have been conducted safely in conventional ^{239}Pu glove boxes which have been modified to accommodate the unusual hazards of ^{238}Pu. The use of the ^{239}Pu facilities has resulted in cost savings since new facilities did not need to be constructed. ^{238}Pu fuels present alpha, gamma, and neutron radiation hazards. The generation of heat and He gas creates additional safety problems. Because of the increased alpha-particle activity, keeping the laboratory air uncontaminated is absolutely essential (the maximum permissible body burden for ^{238}Pu is 1×10^{-9} g). Room and glove-box exhaust systems designed for ^{239}Pu have provided adequate control of alpha contamination. Necessary minor equipment modifications are described. Most of the gamma activity from ^{238}Pu fuel is of low energy and is easily shielded. The dose rate at 10 cm from 100 g of ^{238}Pu shielded by 0.030 in. of Ta is 20 Mrem/hr. Thus glove-box construction, the use of metal containers, and portable lead shielding provide the necessary protection. Neutron dose rates depend upon the chemical composition, chemical purity, and geometry of the ^{238}Pu source. Personnel exposure is controlled by producing chemically pure metals and oxides, and by limiting exposure times to extra hazardous materials such as fluorides. In addition, attenuation by distance is used. The generation of heat, 0.46 W/g Pu, poses several safety problems. Metal sources must be handled in an inert atmosphere to prevent burning. Dry box gloves must be protected from ^{238}Pu dust. Transfer and storage containers must adequately dissipate heat and provide for control of He pressure build-up. Operational experience for the past two years and design of the processing facilities are discussed in detail. Radiation dose rates during processing are discussed as a function of impurities and fuel age. Safe operation of this facility was demonstrated by low personnel exposure history. All exposures have been well below the permissible levels set by the United States Atomic Energy Commission. (auth)

31659 WASTE HANDLING IN THE HOT-CELL LABORATORY OF THE AEG NUCLEAR RESEARCH CENTRE AT GROSS-WELZHEIM. Blass, S.; Lindner, L.; Salber, F. J. (AEG-Telefunken Kernenergieversuchsanlage, Grosswelzheim, Ger.). pp 523-8 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB–238; CONF-691008.

Hot-cell studies of irradiated fuel elements and materials from power reactors in the AEG nuclear research center produce radioactive waste of many different types: liquid waste of both low and high activity, and solid waste such as contaminated objects, irradiated structural materials, and the remains of the fuels examined. The handling of all forms of waste with special reference to radiation shielding and avoiding contamination are described. Special methods and equipment used for packing the medium activity waste inside the cells without contamination of the container are described. By a very simple procedure the liquid waste is solidified with cement. The operation costs are summarized. (auth)

31660 DECONTAMINATION OF PROTECTIVE COVERS AND PERSONAL PROTECTIVE FACILITIES. Gorodinskii, S. M.; Gol'dshtein, D. S. (Inst. of Biophysics, Moscow). pp 567-74 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB–238; CONF-691008.

An important aspect of radiation safety in "hot" cells and laboratories is the prompt decontamination of protective covers and personal protective facilities. Investigations during recent years have indicated the principal ways of improving the methods used in decontaminating protective covers and facilities, which in its turn has necessitated the formulation of fundamental principles for evaluating decontamination methods. The evaluation of methods for decontaminating protective covers and personal protective facilities and of ways of improving such methods is discussed and the results of recent work in this field are presented. (auth)

31661 RADIOLOGICAL PROTECTION PROBLEMS AND EXPERIENCE IN DIRECT MAINTENANCE WORK AT A RADIOCHEMICAL PLANT. Krishnamony, S.; Soman, S. D.; Sundararajan, A. R. (Bhabha Atomic Research Centre, Trombay, India). pp 627-43 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB–238; CONF-691008.

The Fuel Reprocessing Plant at Trombay uses the aqueous Purex process for treating CIRUS fuel (1000 MWd/tonne, cooled for 100 to 300 days). It is designed for "direct maintenance." The plutonium nitrate product is converted to PuO_2 or metal according to requirements. The problems and experience in radiological safety during the operation and maintenance of this plant during the past four years are discussed. The topics particularly covered are: basic containment philosophy, radioactive plant maintenance and related problems, plutonium handling and accident experience at the plant. Relevant radiological health data are presented and discussed from the standpoint of containment performance. Design improvements incorporated in a new fuel reprocessing plant under construction are outlined. (auth)

31662 SAFETY ASPECTS OF RESEARCH WITH RESPIRABLE RADIOACTIVE AEROSOLS. Waligora, S. J. Jr.; Mewhinney, J. A. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Contract AT(29-2)-1013. pp 727-39 of Radiation Safety in Hot Facilities. Vienna; International Atomic Energy Agency (1970).

From Symposium on Radiation Safety Problems in the Design and Operation of Hot Facilities, Saclay, France. See STI/PUB–238; CONF-691008.

Since 1960, the biological consequences of inhaled radionuclides in several species of animals ranging from mice to beagle dogs have been studied. Highly radioactive aerosols, some greater than 0.5 $\mu Ci/cm^3$, generated under controlled conditions for animal inhalation exposures and for supporting research, have included such typical beta and/or gamma emitters as $^{144}Ce-^{144}Pr$, $^{90}Sr-^{90}Y$, ^{91}Y, ^{137}Cs, $^{95}Zr-^{95}Nb$, and alpha emitters such as ^{241}Am. Particle suspensions within the aerosols have been in several soluble forms such as chlorides, and insoluble forms such as fused clay microspheres and metallic oxides. Aerosol generation solutions were prepared to yield particle size distributions that provided a relatively large pulmonary deposition fraction. Because of the nature of the aerosols, special attention has been directed toward minimizing personnel exposure by the design of appropriate facilities and equipment, and the conscientious planning and execution of research operations. Airborne contamination is partly controlled during aerosol generations and inhalation exposures through regulated room pressures and air flow trajectories within the facility. The entire exposure apparatus, remotely controlled, is equipped with a hermetically-sealed exposure chamber and successive stages of filters to preclude release of radioactive material. The infrequent occasions of airborne concentrations in the exposure room characteristically occur when the animals are removed from the exposure chamber. Since the animals and contaminated exposure equipment represent a potential source of resuspended airborne activity for several days post-exposure, special equipment and procedures have been developed to protect personnel. The procedures and precautions for all operations pertaining to the maintenance of exposed animals are reviewed. Decontamination of exposure equipment, from initial disassembly in a dry box with remote manipulators to final cleaning within hoods is described. A case of a low-level but measurable inhalation exposure of a technician during decontamination of equipment used to generate an aerosol of zirconium oxide (^{95}Nb) is described in relation to the pulmonary deposition fraction and the half-time for pulmonary clearance. The experience gained is being used in the design and development of new facilities for this laboratory. (auth)

31663 PROBLEMS OF RADIOACTIVITY IN THE SEA AND THE TASKS OF THE INTERNATIONAL LABORATORY OF MARINE RADIOACTIVITY IN MONACO. Joseph, J. (International Lab. of Marine Radioactivity, Monaco). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 27-33(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The problem of ocean contamination due to radioactive waste disposal into the sea is discussed. It is concluded that worldwide research is necessary to determine the capacity of the sea to take in radioisotopes and that worldwide agreements on the ocean disposal of radioactive wastes must be developed. (L.C.L.)

31664 NATURE OF THE RADIOACTIVE SLUDGE PRODUCED BY PRECIPITATE FLOTATION AND ITS VOLUME REDUCTION TREATMENT. Koyanaka, Yoshio; Tsutsui, Tenson (Kyoto Univ.).

Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 158-60(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The nature of the radioactive sludge produced by precipitate flotation processing of radioactive waste solutions and the dehydration of the sludge by the freeze-thaw method are described. (L.C.L.)

31665 PRESENT STATUS AND FUTURE PROBLEMS IN TRAINING AND EDUCATION OF THE BASIC TECHNIQUES OF RADIOISOTOPE AND RADIATION HANDLING AND THEIR PROTECTION IN JAPAN. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 719-38(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The need for training and education in the handling and use of radioisotopes in Japan is discussed for various groups. These include a general survey and program for the government, postgraduate researchers and engineers, radiation workers in industries, senior high schools, and medical personnel. (P.C.H.)

31666 CRITICALITY MEASUREMENTS ON URANIUM METAL SOLUTION COMBINATIONS. Hunt, D. C.; Rothe, R. E. (Dow Chemical Co., Golden, Colo.). Trans. Amer. Nucl. Soc.; 13: 380-1(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31667 CRITICALITY CALCULATIONS ON URANIUM METAL-SOLUTION COMBINATIONS. Hunt, D. C.; Rothe, R. E. (Dow Chemical Co., Golden, Colo.). Trans. Amer. Nucl. Soc.; 13: 381-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31668 CERTIFICATION OF NUCLEAR CRITICALITY SAFETY SPECIALISTS. Ketzlach, Norman (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 383-4(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31669 MONTE CARLO METHOD AS APPLIED TO NUCLEAR CRITICALITY SAFETY CALCULATIONS. Whitesides, G. E. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc.; 13: 392(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31670 NEUTRON SHIELDING REQUIREMENTS FOR LMFBR AND LWR FUEL SHIPPING CASKS. Arnold, E. D.; Soard, H. F. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 402(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31671 TREATMENT AND DISPOSAL OF RADIOACTIVE WASTES. Krause, Helmut (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.); Perzl, Franz. pp 70-84 of Der Nukleare Brennstoffkreislauf. Essen; Vulkan-Verlag Dr. W. Classen (1969). (In German).

From Meeting of House of Technology, Essen, Germany. See CONF-690338.

It is shown that the presently available decontamination methods permit a safe treatment of wastes from nuclear technology so that in the future no danger to the world need be feared. The methods for the final removal of wastes are suitable for large waste masses and guarantee a safe sealing off from the biosphere over a long time period. (tr-auth)

Vacuum Engineering

31672 (IAE-1869) STUDY OF THE OPERATIONAL CHARACTERISTICS OF THE N-5S PUMP WITH SORPTION TRAPS FOR THE OXIDIZED IRON. Konyaev, V. P.; Maslennikov, E. A.; Pustovoit, Yu. M. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1969. 24p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The operating characteristics of the N-5S pump with "rust" trap are discussed. It was shown that the limiting vacuum of 1.10^{-8} torr is restored after heating the trap to 400°C even after an accidental burst of atmosphere from the preevacuation pump. (auth)

31673 PROPERTIES OF MATERIALS USED IN VACUUM TECHNIQUES. Henry, R. P. Chim. Ind., Genie Chim.; 103: 655-65(Apr 1970). (In French).

The requirements of vacuum techniques necessitate a selection of relatively special materials such as stainless steels and light alloys. Certain recent synthetic elastomers have found applications in ultra vacuum techniques but the polluting nature of oils and greases is progressively restricting their use. (auth) (France)

31674 PRACTICAL ASPECTS OF HIGH VACUUM LEAK DETECTION. Westgaard, Harald (Veeco Instruments Ltd., Portsmouth, Eng.). Vacuum; 20: 143-9(Apr 1970).

Various methods of mass spectrometer leak detection of high vacuum systems and components are discussed, with the emphasis on the practical considerations of the tests and interpretation of the test results. (auth) (UK)

31675 INVESTIGATION OF GASKET COATING MATERIALS FOR ULTRAHIGH-VACUUM SEALS. Danielson, P. M. (Argonne National Lab., Ill.). J. Vac. Sci. Technol.; 7: 449-52(May-Jun 1970).

Ultrahigh vacuum systems are commonly provided with flanged openings that are sealed with copper gaskets. These systems must be baked to at least 250°C in order to achieve ultrahigh vacuum. An investigation of bakeable organic coatings that can be applied to copper gaskets to facilitate sealing conflat flanges on an ultrahigh vacuum system is presented. The coated gaskets have the advantage over uncoated gaskets in that they require fewer flange bolts and lower bolt torques to provide a leak-free seal. The coatings include polyamide and three silicones. Coating techniques, sealing parameters, and vacuum performance of the coated gasket seals are described. The sealing performance of the coating is characterized in terms of pumpdown performance and residual gas analyses. The results of this investigation show that these organic materials can be used for ultrahigh vacuum gasket coatings. They also show that little variation in the partial pressures of the residual gases (after bakeout) occurs when either uncoated or coated copper gaskets are used. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 31362 and 31551.

General Detectors and Monitors

Refer also to abstracts 31654, 31723, 31724, 31808, 32002, 32248, and 33104.

31676 (ANL–7489, pp 1-12) LOCALIZATION OF RADIOACTIVITY IN VIVO BY PHOTON TIME-OF-FLIGHT TECHNIQUES: A PRELIMINARY REPORT. Marinelli, L. D.; Clemente, G. F.; Abu-Shumays, I. K.; Steingraber, O. J. (Argonne National Lab., Ill.).

It is attempted to describe activity distributions over relatively large areas in vivo by determining the spatial scintillation density along adjacent luminescent rods. A block diagram of the electronic components and some preliminary results are presented. (W.H.K.)

31677 (ANL–7489, pp 100-1) EFFECT OF PRESSURE UPON IONIZATION IN PURE RARE GASES. Schultz, Harvey A. (Argonne National Lab., Ill.).

The construction of ionization chambers for measuring the effect of pressure upon W for alpha particles in pure rare gases is described. (W.H.K.)

31678 (ANL–7489, pp 125-7) HIGH-DOSE GAMMA-RAY DOSIMETRY WITH SINGLE-CRYSTAL THERMOLUMINESCENT DOSIMETERS. Paden, Charles (Argonne National Lab., Ill.).

A 600 Ci cesium-137 gamma source (approximately 2000 R/min) was calibrated using single lithium fluoride crystals. The procedure and results are discussed. Dose rates with uncertainty ±2% were obtained. (W.H.K.)

31679 (KURRI-TR–66) SYMPOSIUM ON THE DETERMINATION OF RADIONUCLIDES IN HUMAN BODY USING WHOLE-BODY COUNTER [HELD IN KYOTO, JAPAN, FEBRUARY 22, 1969]. (Kyoto Univ. (Japan). Research Reactor Inst.). [1969]. 108p. (In Japanese). (CONF-690220).

Twenty one papers are presented on the designs and characteristics of whole body counters and phantoms containing calibrating solutions and results obtained using these counters. (C.E.S.)

31680 (NYO–3246-TA-6) RESEARCH ON AVALANCHE TYPE SEMICONDUCTOR RADIATION DETECTORS. Semiannual Report, July–December 1969. Huth, Gerald C.; Hewka, Peter V.; Gelezunas, Vincent L. (General Electric Co., Philadelphia, Pa. Space Div.). Jan 1970. Contract AT(30-1)-3246. 121p. Dep. CFSTI.

Special emphasis has been placed on the continued development of uses of contoured silicon avalanche diodes as solid state radiation detectors and in understanding resistivity striations in silicon to attain silicon of more uniform and higher gain. Large area radiation detectors, low energy electron detection, collaborations in nuclear medicine and biology, and 17 keV x-ray detection considerations are discussed. The applications of avalanche-type detectors in nuclear medicine for beta, gamma, and x-ray detection are discussed. Considerations concerning specific isotopes in nuclear medical applications are presented including soft x-ray emitters (^{55}Fe and ^{41}Ca), ^{238}Pu and ^{239}Pu, ^{14}C, soft beta emitters (^{45}Ca and ^{35}S), tritium, and high energy beta emitters (^{32}P, ^{85}Kr, and ^{90}Sr). (W.H.K.)

31681 INVESTIGATION OF DISTORTIONS IN GAMMA CAMERA SCINTIGRAPHIC PICTURES. Tolwinski, J.; Mackiewicz, H.; Siwicki, H.; Tarkowski, W.; Jasinski, W. K. (Inst. of Oncology, Warsaw). Contract 665/RB. Nucl.-Med.; 9: 70-7(1970).

Pictures of a homogenous volume source of activity registered in the memory of the analyzer, show large differences in counts from channel to channel which result in picture distortions. The aim of this investigation was to develop a simple measuring test to define the degree of distortion caused by the uneven response of the scintillation camera detector. The effect of three parameters on the degree and kind of distortion in pictures obtained from a 1600-channel analyzer was investigated. These parameters were: the time period between camera tunings, the activity of the source, and the number of collected data. Measurements were made with a scintillation camera Nuclear-Chicago Pho/Gamma II combined with a 1600-channel analyzer. (auth)

31682 THE DIVERGING COLLIMATOR. Muehllehner, G. Nucl.-Med.; 9: 84-94(1970).

The diverging collimator makes it possible to increase the field of view of a radioisotope imaging camera. The larger field of view is obtained by sacrificing efficiency per unit area of the field of view while preserving the resolution of the system. This situation is analogous to that of the scanner, where the efficiency per unit area is inversely proportional to the total area scanned. Efficiency and resolution of diverging collimators can be calculated quite accurately as is evidenced by the good agreement between calculated and measured values. The problem of septum penetration, however, needs to be further investigated for both parallel-hole as well as diverging collimators, so that the influence of the shape and arrangement of the holes upon septum penetration is taken into account. (auth)

31683 POSSIBLE USE OF SCINTILLATORS FOR DOSIMETRY OF COSMIC RADIATION PROTONS. Markelov, V. V.; Redko, V. I.; Stepanov, A. S. Kosm. Biol. Med.; 4: No. 2, 24-8(Mar-Apr 1970). (In Russian).

Basic dosimetric parameters of organic crystal scintillators in relation to their use for dosimetry of cosmic radiation protons are discussed. It gives the value of the error (the maximum error being below 15%) as estimated when measuring the tissue dose produced by protons of the energy spectrum $(dN/dE) = N_0 \cdot E^{-\gamma}$ with the aid of an anthracene crystal scintillometer. The error has been found to depend on the spectrum characteristics and shielding thickness. (auth)

31684 MEASUREMENT OF FISSION RATIOS IN ZERO POWER REACTORS USING SOLID-STATE TRACK RECORDERS. Besant, C. B. (Imperial Coll. of Science and Tech., London); Ipson, S. S. J. Nucl. Energy; 24: 59-69(Apr 1970).

Fission ratio measurements provide information in studies of the neutron events in both thermal and fast reactors. Commonly induced fission product activity in fissile foils is counted. The use is described of a technique for counting fission tracks in plastic films which were etched after irradiation to make tracks visible. The tracks were counted using standard microscopy techniques and an automatic technique. Both methods are potentially of high accuracy, the latter removes the laborious work of counting tracks by eye. (auth) (UK)

31685 REDUCTION OF THE EFFECT CAUSED BY THE COSMIC RADIATION IN LOW-BACKGROUND β-SCINTILLATION MEASUREMENTS. Dimchev, T.; Avramov, S. (Inst. of Physics, Sofia). Isotopenpraxis; 6: 53-7(Feb. 1970).

The existing possibilities of reduction of the variable background component by the cosmic radiation are analyzed. Scintillating detectors with thin plastic scintillators and low-noise photomultipliers are used. The bidirectional anticoincidence circuit is applied. The main detectors used for taking the measurements of the sample are used at the same time for self-screening against the cosmic radiation. The measurements are taken in a geometry approaching 4 π. The method is effective for measuring thin samples after a radiochemical separation of the activity. A reduction of the background to 0.25 puls/min is achieved without any sophisticated shielding or special demands for radiochemical purity of the materials or the premises. The small weight of the equipment makes it convenient for transportation and fit for measurements in transportable laboratories. (auth)

31686 RECORDING OF IONIZING PARTICLE TRACKS IN CELLULOSE FILMS IN VARIOUS GASEOUS MEDIA. Kartuzhanskii, A. L.; Privalova, V. E.; Sorokin, E. S.; Fedyukin, V. Ya. (Leningrad Inst. of Soviet Commerce). Zh. Nauch. Prikl. Fotogr. Kinematogr.; 15: 59-61(Jan-Feb 1970). (In Russian).

Particle track recording on cellulose films was studied using α-particles of ^{210}Po (at 5.3 MeV energy) and nitrocellulose and acetyl cellulose films. The exposure was carried out in a vacuum (as 2×10^{-4} mm Hz) or with oxygen, carbon dioxide, or water vapor at various pressures. Histograms of the distribution of ^{210}Po particle tracks by their length in nitrocellulose film exposed in various gaseous media are included. (R.V.J.)

31687 WHOLE BODY COUNTER. Okajima, Shunzo; Norimura, Toshiyuki; Abe, Takeo; Shakei, Ho (Nagasaki Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 98-9(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Circuits, calibration data, and modes of operation of the pair of scanning scintillation detectors at Nagasaki University for whole-body counting are described. (W.H.K.)

31688 WHOLE BODY COUNTING WITH MULTIPLE-DETECTOR SYSTEM. Kakehi, H.; Arimizu, N.; Uchiyama, G.; Saegusa, K.; Arima, A.; Akezuma, K. (Chiba Univ., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 100-2(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The performance of multiple scintillation detector whole-body counters at Chiba University is discussed. (W.H.K.)

31689 CLOTHING CONTAMINATION MONITOR FOR β RAY. Mito, Norio (Japan Atomic Energy Research Inst., Tokyo); Okuyama, Noboru; Yamaguchi, Seiji; Shiojiri, Takamasa; Seki, Yoshito; Tomihisa, Katsuyuki. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 103-5(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

An 18-detector array of GM detectors with a ratemeter–alarm system is described for beta monitoring the contaminated clothing of laboratory and plant workers. When the counting rate exceeds the preset level, the contaminated clothing is automatically marked by a spray paint system. (W.H.K.)

31690 PORTABLE ALARM METER. Kasai, Takeo; Hayashi, Osamu; Iwatsuki, Tsunenobu. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 106(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A portable ionization chamber dosimeter with an alarm system and also an electrometer circuit for immediate readout is described. (W.H.K.)

31691 PROPERTIES OF NEW FISSION TRACK DETECTOR GLASS. Yokota, Ryosuke (Central Research Lab., Toshiba, Japan); Muto, Yehei; Tanzawa, Katsujiro; Tsuruta, Takao. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 229-30(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Properties of dielectric track detectors of phosphate glass doped with thorium, natural uranium, or depleted uranium are briefly discussed. The detectors can be used for crude energy spectrum measurements of neutrons. (W.H.K.)

31692 MEASUREMENTS OF REACTOR NEUTRON FLUX BY FISSION TRACK METHOD. Hashimoto, T. (Kyoto Univ.); Iwata, S.; Nishimura, S.; Nakanishi, T.; Sakanoue, M. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 231-4(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The procedure and results of reactor neutron flux measurements using fission foils of natural uranium and thorium with mica and polycarbonate track detectors are discussed. (W.H.K.)

31693 VARIABLE FOCUS COLLIMATOR. Saito, Hiroshi; Mishima, Atsushi (Nagoya Univ., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 343-5(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Two variable focus collimators for use in radioisotope scanning, including pipes soaked in mercury and lead plates with tapered holes, are briefly described. (W.H.K.)

31694 BODY SECTION SCINTIGRAM USING AN ANGER CAMERA. Tateno, Yukio; Kakehi, Hirotake; Arimizu, Noboru; Kawana, Masao (Chiba Univ., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 346(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The techniques for body section scintigraphy using an Anger camera are discussed. The resolution was demonstrated on scintigrams of phantoms and resolution patterns. (W.H.K.)

31695 NEW DESIGN OF 5" WHOLE BODY SCANNER. Kakehi, H. (Chiba Univ., Japan); Arimizu, N.; Uchiyama, G.; Saegusa, K.; Baba, K.; Yamaguchi, H. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 347-9(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The design and performance of a whole-body scanner are described. The scanner utilizes two 5 inch NaI crystals with improved collimator design for increased resolution and sensitivity and decreased scanning time. (W.H.K.)

31696 CHARACTERISTICS OF TOSHIBA GAMMA CAMERA. Kumano, Nobuo; Kurihara, Shigeyasu; Kashio, Eiji (Tokyo Shibaura Electric Co. Ltd.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 353(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The TOSHIBA gamma camera is briefly described, and the use of an absorber around the edge of the scintillation crystal to reduce scattering effects is illustrated. (W.H.K.)

31697 SOLAR SLIT CAMERA. Fukao, Yoshiro; Kashio, Eiji; Kurihara, Shigeyasu; Ito, Toyaki; Saito, Katsuyoshi; Asahina, Kiyotake (Tokyo Shibaura Electric Co., Ltd.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 354(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A new type scintillation camera is described. The camera employs a multislit collimator and 25 slit scintillators with light pipes and photomultipliers arranged so that the entire collimator–detector head is rotated. Tests using point sources show high sensitivity but poor resolution. (W.H.K.)

31698 SPARK CHAMBER TYPE GAMMA CAMERA. Miyazawa, T.; Kamei, H.; Fujii, I.; Kubo, K. (Tokyo Shibaura Electric Co., Ltd.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 355-7(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The design of a gamma camera using a spark chamber detector is described. Characteristics of the camera are discussed including resolution and efficiency. (W.H.K.)

31699 CATHETER-TYPE SEMICONDUCTOR RADIATION DETECTOR FOR THE DIAGNOSIS OF MALIGNANT TUMOR. Higashi, T. (Kanagawa Dental Coll., Japan); Ikemoto, S.; Doke, A.; Miyashita, K.; Fujikawa, K.; Takata, M.; Iwakishi, A.; Oda, M.; Hama, M. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 358-60(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A catheter-type p–n silicon detector which is less than 2.5 mm in diameter is described. The spectrum of phosphorus-32 in solution obtained by a catheter-type detector is illustrated. (W.H.K.)

31700 CATHETER-TYPE SEMICONDUCTOR DETECTOR FOR THE DIAGNOSIS OF MALIGNANT TUMORS IN THE LUNG, ESOPHAGUS, STOMACH, AND UTERUS. Takayanagi, S. (Tokyo Shibaura Electric Co., Ltd.); Kobayashi, T.; Sugita, T.; (and others). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 361-3(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The catheter-type semiconductor radiation detector (CASRAD), which consists of a 2.3 mm-diameter silicon p–n junction diode, is described. Results of the diagnosis of malignant tumors in the esophagus, lung, stomach, and uterus using phosphorus-32 tracer are discussed. (W.H.K.)

31701 OPERATIONAL COUNT RATE METERS AND THEIR APPLICATION TO NUCLEAR MEDICINE. Tanaka, Eiichi; Iinuma, Takeshi A. (National Inst. of Radiological Sciences, Chiba, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 364-6(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The design and basic equations of under-damped count rate meters which use two pairs of CR elements and operation amplifiers are presented. The under-damped operational rate meter was used to enhance the high frequency component of the signal and to recover the details of the profile image in a radioisotope scanner. Results are presented. (W.H.K.)

31702 EXPERIMENTS FOR THE QUANTITATIVE DETERMINATION OF RADIOISOTOPE DISTRIBUTION IN THE BODY USING THE RING-TYPE TOTAL BODY COUNTER. Tamiya, Tadashi; Nishizawa, Kunihide; Saito, Hiroshi (Nagoya Univ., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 367-9 (1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The fundamental studies for the quantitative determination of radioisotope distribution in the body sections are needed for the determination of the exact amount of radioisotope in the whole body. The methods of obtaining correction factors related to the radius of the traverse body section, site and size of distribution of the radioisotope in the section are reported. (auth)

31703 APPLICATION OF DIGITAL TECHNIQUE TO RADIOISOTOPE IMAGING. Iinuma, T. A.; Tanaka, E.; Nagai, T.; Fukuda, N. (National Inst. of Radiological Sciences, Chiba,

Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 370-3 (1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

An on-line computer data acquisition system for a rectilinear scanner and a scintillation camera is briefly described, and methods for image processing and display are discussed. (W.H.K.)

31704 CONSTRUCTION OF FUNCTIONAL IMAGE FROM LOCALIZED RATE CONSTANTS. Kaihara, Shigekoto (Tokyo Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 374-6 (1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Function measurements based on the rate of change of radioisotope content in the region are discussed. The possibility of constructing functional images from rate constants for assessing the regional function of certain organs is analyzed. (W.H.K.)

31705 QUANTITATIVE MEASUREMENTS OF RADIOACTIVITY DEPOSITED IN INTERNAL ORGANS USING COMPUTER ANALYSIS OF SCINTIGRAPHY. Arimizu, Noboru (Chiba Univ., Japan); Kaehi, Hirotake; Morris, A. C. Jr. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 378-81(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A study to determine whether a scintigraphy can supply additional information toward the quantitative uptake measurement of radioisotopes deposited in internal organs and to explore methods of making these measurements more accurate and speedy by the aid of computer processing is described. A number of methods such as color recording and computer processing scintigram have been used to increase contrast and diagnostic interpretability. These manipulations and records have not given the quantity of radioisotopes present. (W.H.K.)

31706 AN APPLICATION OF DIGITAL COMPUTER FOR THE QUANTITATIVE DETERMINATION OF RADIOISOTOPE DISTRIBUTION IN THE BODY SECTIONS WITH RING-TYPE TOTAL BODY COUNTER. Nishizawa, Kunihide; Tamiya, Tadashi; Saito, Hiroshi (Nagoya Univ., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 392-4(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Fundamental studies on the counting characteristics of one detector were carried out for the quantitative determination of radioisotope distribution in the body sections with the Ring-type Total Body Counter. A human body section was divided into many small area elements, and the characteristics of calculation in varied counts of the same radioisotope at various sites in the section were investigated with a fixed counting system and variable location of radioisotopes. The charts filled with the ratio of counts of a radioisotope in standard locations to others were made by using the digital computer. From these charts, if we know the radioactivity of a nuclide in a certain position, the amount of the distributed radioisotope can be determined. Moreover, the radioisotope distributed in the traverse body section can be taken for a point source approximately. (auth)

31707 APPLICATION OF ANTHRACENE FLOW CELL COUNTER TO THE STUDY OF AMINO ACID METABOLISM. Yamada, Yoshio; Shiraishi, Jun; Ikeda, Motoki (Kyushu Univ., Fukuoka). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 417-19(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

An automatic anthracene flow cell counter, developed to measure the activity of carbon-14 and other soft β-emitters in flowing aqueous streams, is described. Applications and problems in using this system for separation and determination of labeled amino acids are discussed. (W.H.K.)

31708 NEUTRON CRITICALITY DETECTION SYSTEM (13 Apr 1970) (Engineering Materials). (Richland Operation Office (AEC), Wash.). (CAPE-1997).
8 drawings.

This system, after detecting a criticality by measuring neutron density, warns personnel of the criticality by activating the criticality alarm system. The detector is a BF_3 chamber with appropriate amplifiers and discriminators whose output activates relay contacts. Filtered incoming detector power and outgoing trip signals prevent spurious trips from ac power transients. A comparator activates a local alarm on receiving one critical signal, and on receiving two or more signals activates the criticality howlers. The comparator activates a local alarm upon receipt of a failure signal from any one of the detectors or upon loss of incoming ac power. (For details see TID-4100 Suppl. 58) (F.S.)

31709 IMPOSING OF A FIXED DEAD TIME. Seda, Josef (Technical Univ., Prague). Jad. Energ.; 16: 193-5(Jul 1970).

A method of imposing a fixed dead time of the measuring channel with a G. M. counter or a scintillation detector is described. In case of G. M. counters the imposed dead time is defined by lowering the operating voltage below the cutoff level of the counter. In case of scintillation detector the imposed dead time is defined by negative pulses applied to the grid of the photomultiplier. (auth)

31710 DETECTION OF NUCLEAR RADIATION USING THE CUMULATIVE PHOTODIELECTRIC EFFECT IN CADMIUM SULFIDE. Alworth, Charles Wesley. Norman, Okla.; Univ. of Oklahoma (1969). 122p.
Thesis.

The field of nuclear radiation detection is limited at the low energy scale. Present day radiation detectors have a practical lower limit of approximately 1 keV for alpha, beta, and gamma. This lower limit is due to noise in the detectors themselves and their associated electronic circuits. The present study of x-radiation from color television receivers requires a lower energy range from the radiation detection equipment. Future applications of radioisotope tracer techniques will need a high sensitivity radiation detector. The cumulative photodielectric effect uses the ac mode of radiation detection to improve the signal to noise ratio, and extend the lower energy limit to the theoretical limit of 2.53 eV, which is the value of the bandgap in cadmium sulfide. Cadmium sulfide exhibits the photodielectric effect between 0 and 200°K. This work makes use of this property to study the ac mode of radiation detection. The work first traces the background of nuclear radiation detectors, and examines the only previous work in the area of the ac mode. The work also discusses the interaction of radiation with matter. Next a discussion of the electron traps in cadmium sulfide which are responsible for the photodielectric effect are discussed. Primary emphasis is on the effect of radiation on the dielectric constant of cadmium sulfide, and a series of equations is derived explaining the change in the dielectric constant due to radiation. Experimental procedures are explained, along with the preliminary design problems and preparations. Techniques for measuring the change in dielectric constant using radiofrequency electromagnetic waves are explained. Finally, the work demonstrates that the cumulative photodielectric effect can be used to detect low intensity, low energy beta particles. In this case the source of radiation used was radioactive carbon-14. (Disser. Abstr.)

31711 THE GOLD-SILICON SURFACE BARRIER DETECTOR. II. Liu, Yuen-chung; Tzeng, Huw-shing; King, Ming-ming; Kun, Lin-ing; Cheng, Vianney Kuo-chuan (National Tsing Hua Univ., Hsinchu, Taiwan). Chin. J. Phys. (Taiwan); 7: 86-8(Oct 1969).

A method for edge protection and mounting of surface-barrier detectors is described which improves the resolution to 44 keV for alpha particles. The energy spectra of $^{27}Al(d,\alpha)^{25}Mg$ reactions and also $^{6}Li(n,\alpha)^{3}H$ reactions are shown. (W.H.K.)

31712 DUAL MICROSCOPE COMPARATOR FOR FISSION TRACK STUDIES. Dooley, J. R. Jr.; Taylor, R. B.; Jurceka, F. J. (Geological Survey, Denver). Rev. Sci. Instrum.; 41: 887-8(Jun 1970).

Two monocular microscopes have been simply combined, making use of a single stage and adjustable specimen holder, to facilitate uranium distribution studies by the induced fission track method. The sample and Lexan fission track detector can be readily compared at magnifications from about 25 to 400×. The dual microscope comparator is a practical instrument for rapid visual correlation of fission tracks with their uranium bearing source with a precision approaching the etched track length in Lexan ($\approx$14 μ). (W.H.K.)

31713 PULSE SHAPE DISCRIMINATION WITH Si(Li) DETECTORS BY MEANS OF A NULL-TRANSMISSION METHOD. Fuelle, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Mathe, Gy. Acta Phys. Acad. Sci. Hung.; 28: 191-215 (1970). (In German).

Particle discrimination was investigated by means of pulse shape analysis using p-i-n silicon detectors. A null transmission method was used, which was originally developed for scintillation counters. The pulse shape and the null transmission time were calculated in dependence on the particle transmission range, and parameters were determined for the best particle separation. Alpha particles were separated from protons and deuterons using a 1.5 mm thick detector. The measurements confirm the results of calculations. (tr-auth)

31714 ENVIRONMENTAL NEUTRON MEASUREMENTS WITH SOLID-STATE TRACK RECORDERS. Roberts, J. H. (Macalester Coll., St. Paul, Minn.); Congel, F. J.; Armani, R. J.; Gold, R.; Kastner, J.; Oltman, B. G. Trans. Amer. Nucl. Soc.; 13: 419-20(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31715 DETECTION OF ^{4}He PARTICLES AND RECOIL NUCLEI PRODUCED BY HIGH-ENERGY NEUTRONS IN DIELECTRIC PLASTICS. Frank, A. L.; Benton, E. V. (Univ. of San Francisco, Calif.). Trans. Amer. Nucl. Soc.; 13: 420(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31716 LIQUID ORGANIC FAST-NEUTRON DETECTOR ASSEMBLY. Simons, G. G.; Larson, J. M. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 13: 429-30(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31717 MEASUREMENT OF NEUTRON FLUENCE BY ^{237}Np AND ^{238}U FISSION DOSIMETERS. Barry, K. M. (Westinghouse Electric Corp., Pittsburgh); Corbett, J. A. Trans. Amer. Nucl. Soc.; 13: 431-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31718 NEW ITERATIVE METHOD FOR UNFOLDING MULTIPLE FOIL ACTIVATION DATA. Fortney, R. E. (TRW Systems, Redondo Beach, Calif.); Levine, S. H. Trans. Amer. Nucl. Soc.; 13: 432(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31719 X-RAY ANALYSIS OF THYROIDAL IODINE. Collins, L.; Myhill, J. (Royal North Shore Hospital, Sydney). Australas. Bull. Med. Phys. Biophys.; No. 43, 12-23(Mar 1970). (CONF-690830-2).

From Ninth Annual Meeting of Physics in Medicine and Biology, Perth, Australia.

The problem and means of constructing suitable measuring equipment to compare the absorption of externally applied x rays by the thyroid gland, to tracer analysis techniques, is reviewed. A 300mCi (170mCi effective) americium-241 source for exciting lanthanum K_{α} x rays in a Roy-type system gave encouraging results, the major disadvantage being a count rate <800cps. (Australia)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 32912.

31720 (UCRL-19452) SAMPO: A FORTRAN IV PROGRAM FOR COMPUTER ANALYSIS OF GAMMA SPECTRA FROM Ge(Li) DETECTORS, AND FOR OTHER SPECTRA WITH PEAKS. Routti, Jorma T. (California Univ., Berkeley. Lawrence Radiation Lab.). 20 Oct 1969. Contract W-7405-eng-48. 34p. Dep. CFSTI.

SAMPO is a Fortran IV program written to perform the data-reduction analysis described by J. T. Routti and S. G. Prussin in Photopeak Method for the Computer Analysis of Gamma-Ray Spectra from Semiconductor Detectors, Nuclear Instruments and Methods 72, 125-142 (1969). The code has also been used to analyze other spectra with peaks and continua. Program SAMPO can be used for an automatic off-line or an interactive on-line analysis. It includes algorithms for line-shape, energy, and efficiency calibrations, and peak-search and peak-fitting routines. Different options are available to make the code applicable to accurate nuclear spectroscopic work as well as to routine data reduction. The mathematical methods and their coding are briefly described. Instructions for using the program and for preparing input data are given and the optimal strategies for running the code are discussed. Instructions are given for using the LRL program library version of SAMPO and for obtaining source decks. (auth)

31721 LOW-BACKGROUND β-RAY SPECTROMETER. Tanaka, Eiichi (National Inst. of Radiological Sciences, Chiba, Japan); Hiramoto, Toshiyuki; Miwa, Hirohide; Morita, Itsuo; Mizukoshi, Tsutomu; Yoshida, Tetsuo; Iwata, Minoru. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 149-51(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The low-background beta spectrometer PICOBETA which uses a GM and scintillation detector in coincidence for low-level spectroscopy is described. Specifications, performance, and uses of PICOBETA are discussed. (W.H.K.)

31722 COMPARISON OF β-RAY MEASUREMENT AND γ-RAY MEASUREMENT FOR LOW-LEVEL SAMPLES. Shiojiri, Takamasa; Iwata, Minoru. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 152-4(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Figure of merit values which represent the sensitivities of the instruments are compared for the PICOBETA low-background beta spectrometer and a 5 × 5" NaI(Tl) scintillation gamma spectrometer. Results are tabulated for various beta-gamma emitters, for pure gamma emitters, and for pure beta emitters. (W.H.K.)

31723 SOLID STATE TRACK DETECTOR AND ITS APPLICATION (FISSION CROSS SECTION MEASUREMENTS). Sakanoue, Masanobu; Nakanishi, Takashi (Kanazawa Univ., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 220-2(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Techniques and performance of dielectric track detectors for fast-neutron fission cross section measurements are discussed. (W.H.K.)

31724 APPLICATION OF SOLID-STATE TRACK DETECTOR FOR RdTh DAUGHTER NUCLIDES AND THEIR ALPHA PARTICLES. Shinagawa, M.; Takemi, H.; Kinaga, Y.; Nishizawa, K.; Narisada, K. (Osaka Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 226-8(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Dielectric track detectors were used to study the surface of electrodes of fractionally deposited thorium-228 decay products on nickel targets. The relation between the diameter of the alpha tracks of lead-212 and etching time and an alpha track spectrum of lead-212 are presented. (W.H.K.)

31725 NEUTRON-DIFFRACTION STUDIES IN THE INST. FOR NUCLEAR RESEARCH AT THE CZECHOSLOVAK ACADEMY OF SCIENCES. Khalupa, B.; Mikhalets, R.; Vavra, Ya. At. Energ. (USSR); 28: 413-17(May 1970). (In Russian).

Theoretical and experimental data for slow neutron spectrometers obtained by the CzSSR Institute for Nuclear Research are analyzed. A two-axis crystalline spectrometer was constructed in order to carry out spectrometric and diffraction measurements with polarized and nonpolarized slow monochromatic neutron beams. Diffraction of polarized neutrons on ferromagnetic monocrystals was studied as well as the interactions of neutrons with the oscillating lattice in ordered structures. Data were obtained for monocrystal quartz and magnetostriction of excited ferromagnetic monocrystals. Neutron diffraction by oscillating and non-oscillating monocrystals was analyzed and the application of these effects in neutron spectrometry in piezoelectric and magnetostriction zones was discussed. (R.V.J.)

31726 FACTORS DETERMINING THE ULTIMATE DETECTION SENSITIVITY OF Ge(Li) GAMMA-RAY SPECTROMETERS. Cooper, J. A. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 75-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31727 ANTICOINCIDENCE-SHIELDED DUAL Ge(Li) GAMMA-RAY SPECTROMETER FOR LOW-LEVEL COUNTING. Cooper, J. A.; Perkins, R. W.; Kosorok, J. R. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 76-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31728 LOW-ENERGY LIMITATIONS ON PROTON-RECOIL SPECTROSCOPY THROUGH THE ENERGY DEPENDENCE OF W. Bennett, E. F. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 269(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31729 HIGH-ENERGY LIMITATIONS IN NEUTRON SPECTROMETRY WITH PROTON-RECOIL PROPORTIONAL COUNTERS. Yule, T. J. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 269-70(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31730 NEUTRON SPECTRAL MEASUREMENTS IN WATER AND BEHIND IRON SLABS NEAR THE PUR-I REACTOR USING A RECENTLY DEVELOPED PROTON-RECOIL SPECTROMETER.

Paulson, C. Keith; Livengood, C. David; Hungerford, H. E. (Purdue Univ., Lafayette, Ind.). Trans. Amer. Nucl. Soc.; 13: 403 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31731 COMPTON RECOIL MEASUREMENT OF CONTINUOUS GAMMA-RAY SPECTRA. Gold, Raymond (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 421(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31732 ACTIVATION FOIL SPECTROMETRY: ENERGIES LESS THAN 14 MeV. McElroy, W. N. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 422-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31733 ACTIVATION FOIL SPECTROMETRY: ENERGIES NEAR 14 MeV. Barrall, R. C. (Stanford Univ., Calif.). Trans. Amer. Nucl. Soc.; 13: 423(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31734 SMALL DIFFERENTIABLE LIQUID SCINTILLATOR NEUTRON SPECTROMETER. Shook, Donald F. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 13: 430-1(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

High Energy Physics Instrumentation

31735 SPARK CHAMBERS IN HIGH-ENERGY PHYSICS. PART I. MULTIELECTRODE SPARK CHAMBERS. Dwurazny, Antoni (Univ., Lodz, Poland); Waligorski, Michal. Postepy Fiz.; 21: 269-94(1970). (In Polish).

Multielectrode spark chambers are described and their application in experimental high-energy physics is discussed. A brief theory of electric breakdown in gases is also given. This is the first part of a review on spark chambers. 47 references. (auth)

Radiation Dosimeters

Refer also to abstracts 31683, 31690, 31717, and 31981.

31736 (ANL-7489, pp 124-5) LINEARITY OF RESPONSE FOR LiF AT LOW EXPOSURES. Tedeschi, P.; Oltman, B. G.; Kastner, J. (Argonne National Lab., Ill.).

The response of lithium fluoride ILD was tested at low doses (0 to 600 mrad) and found to be linear. (W.H.K.)

31737 (ICRU-14) RADIATION DOSIMETRY: X RAYS AND GAMMA RAYS WITH MAXIMUM PHOTON ENERGIES BETWEEN 0.6 AND 50 MeV. (International Commission on Radiation Units and Measurements, Washington, D. C.). 15 Sep 1969. 30p. ICRU, Washington, D. C. $2.50.

Methods for standardization of absorbed dose of x and gamma rays from 0.6 to 50 MeV are described. Determination of absorbed dose by ionization methods, chemical methods, and calorimetric methods are discussed; and transfer of an absorbed dose calibration to another center is considered. 113 references. (W.H.K.)

31738 (JUL-640-ST) EXPERIENCE IN PRACTICAL RADIATION PROTECTION WITH THERMOLUMINESCENCE DOSIMETERS FOR DETERMINATION OF DOSES OF PARTIAL-BODY RADIATION. Heinzelmann, M. (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Strahlenschutz). Feb 1970. 20p. (In German). Dep. CFSTI (U. S. Sales Only).

The methods and results of the first year's study in the determination of the partial-body doses (especially of the hands and fingers) with thermoluminescence dosimeters are compiled. The results were compared with the results of dosimeter films carried on an arm band and on the finger ring. The comparison showed that the film dosimeter was not suitable to the determination of the maximum value of the dose to the hands. (tr-auth)

31739 METHOD FOR MEASURING THE X-RADIATION DOSE BY MEANS OF A LARGE-SURFACE FILM DOSIMETER. Bojtor, Ivan (Inst. for Radiobiology and Health Physics, Budapest). Magy. Fiz. Foly.; 17: 469-72(1969). (In Hungarian).

The dose absorbed in the body is usually determined by indirect methods; the surface dose is best measured by a large-surface film dosimeter, because it is able to take into account both the direct and the scattered components of the radiation. The author's previously described large integral film dosimeter was evaluated mathematically, using a computer program for solving the numerical problem. The method was illustrated on a film containing the results of measurements on 400 persons who wore it during chest x-ray exposure. The blackening of the film was determined at 595 points, using graphic integration for determining the radiation of medical origin for a given population. (TTT)

31740 STUDIES ON THE LiF THERMOLUMINESCENT DOSIMETRY. Naba, Katsumi (Japan Defence Agency, Tokyo); Murayama, Yoshihiko; Takahashi, Masao; Ooshima, Toshinori; Maekawa, Kan. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 129-31(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The sensitivity of lithium fluoride thermoluminescent dosimeters was studied with various activation impurities. Fading as a function of storage time, fading of spurious luminescence, and heat pretreatment for quenching spurious luminescence were measured. (W.H.K.)

31741 RADIATION DOSIMETRY BY THERMOLUMINESCENCE IN RARE-EARTH-ACTIVATED Y_2O_3 PHOSPHORS. Ato, Yasuro (Government Industrial Research Inst., Nagoya, Japan); Miyagawa, Soji; Huzimura, Ryoitiro. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 132-3(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Thermoluminescence properties of europium-activated yttrium oxide and its derivative phosphors were studied. The response of various phosphors, fading as a function of storage time, and response vs dose are shown graphically. (W.H.K.)

31742 EFFECT OF ATMOSPHERE AND CRYSTAL-GRAIN SIZE ON THERMOLUMINESCENCE SENSITIVITY OF ANNEALED LiF CRYSTALS. Nakajima, Toshiyuki (National Inst. of Radiological Sciences, Chiba, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 134-6(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The effects of the atmosphere and the grain size of crystals on the enhancement of sensitivity during thermal annealing of lithium fluoride crystals for thermoluminescence dosimetry were studied. Crystals of various sizes from 30 to 1000 μ were annealed in air, argon, or in vacuum for 30 min to 4 days at specified temperatures between 300 and 700°C. Results are presented. (W.H.K.)

31743 DOSIMETRY OF BETA-RAY SOURCES WITH SPECIAL REFERENCE TO ^{90}Y. Elmanharawy, M. S. (Univ. of Cairo). Isotope Radiat. Res.; 2: 1-8(Jun 1969).

Various aspects of beta-ray dosimetry are discussed with special consideration to the dosimetry of yttrium-90 sources. Theoretical treatments are outlined for calculating the beta-dose within and outside these sources; the experimental technique is also described. Calibration factors, depth-dose curves and isodose lines are obtained for ^{90}Y rods and are in agreement with data published by other workers on ^{90}Y. (auth)

31744 DIRECT DETERMINATION OF NEUTRON DOSE USING SPHERICAL PROPORTIONAL COUNTERS. Lucas, A. C.; Quam, W. M.; Wilde, W. (Edgerton, Germeshausen and Grier, Santa Barbara, Calif.). Trans. Amer. Nucl. Soc.; 13: 417(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31745 EXPERIENCE WITH AN LET SPECTROMETER AND PORTABLE REM METER. Phillips, L. F.; Kuehner, A. V.; Baum, J. W. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 13: 417-18(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31746 TISSUE-EQUIVALENT PROPORTIONAL COUNTERS IN NEUTRON SHIELD EFFECTIVENESS STUDIES. Brackenbush, L. W.; Endres, G. W. R.; Faust, L. G. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 418-19(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31747 HEAVY PARTICLE APOLLO ASTRONAUT DOSIMETRY. Benton, E. V. (Univ. of San Francisco, Calif.); Henke, R. P.; Richmond, R. Trans. Amer. Nucl. Soc.; 13: 419(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31748 THERMOLUMINESCENT DOSIMETRY FOR SHIELDING STUDIES IN A REACTOR ENVIRONMENT. Tochilin, E. (Environmental Science Associates, Burlingame, Calif.). Trans. Amer. Nucl. Soc.; 13: 420-1(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31749 GAMMA-RAY DOSIMETRY USING COMPTON SCATTERED ELECTRONS. Myers, Dennis M.; Wacks, Morton E. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 13: 434-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Radiometric Instruments

Refer also to abstracts 31283, 31481, and 32525.

31750 ASH CONTENT METER USING RADIATION. Mizukoshi, Tsutomu; Terai, Etsuji; Maki, Kiyoshi Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 121-2(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The development of a gamma radiometric gage for determination of ash content in coal is described. Americium-241 and cesium-137 gamma sources are used. The specifications of the meter are listed. (W.H.K.)

31751 EFFECT OF SCATTERED GAMMA RAYS ON THE ENHANCEMENT OF FLUORESCENCE X RAYS IN GAMMA-RAY GAUGING. Kaminishi, Tokishi; Nishimura, Kintaro (Government Industrial Research Inst., Nagoya, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 137-9(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The fluorescence x-rays excited by scattered gamma rays in gamma radiometric gaging were studied. Various plane targets and a cesium-137 gamma source were used with a NaI detector for the measurements. (W.H.K.)

31752 ON STREAM RADIOISOTOPE X-RAY ANALYZER FOR THE DETERMINATION OF Ca CONTENT IN RAW CEMENT. Tanemura, Takashi; Suita, Hiroshi; Takamuku, Atsushi; Nishida, Koichi (Rigaku Denki Co., Ltd., Tokyo. Mitsubishi Cement Co., Ltd., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 215-16(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

An x-ray fluorescence analyzer for continuous determination of calcium in raw cement is described for on-line quality control. An iron-55 x-ray source is used with a radiation detector and counting rate meter. (W.H.K.)

31753 DEVELOPMENT OF PORTABLE X-RAY FLUORESCENCE ANALYZER WITH SOLID STATE DETECTOR. Tominaga, Hiroshi; Enomoto, Shigemasa (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 217-19(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The Si(Li) semiconductor detector, preamplifier, cryostat, and dewar are briefly described; and a schematic of the system is given. (W.H.K.)

31754 CALIBRATION CURVES IN GAMMA-GAMMA LOGGING. Wada, Nobuo; Tominaga, Hiroshi; Tachikawa, Noboru; Kobayashi, Masatoshi (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 250-2(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Experiments to determine the influence of bore hole diameter and of ground water in the bore hole on the response of a depth-type gamma scattering soil density meter which uses a ^{60}Co source are described, and the calibration curves obtained are presented. (L.C.L.)

Miscellaneous Instruments and Components

Refer also to abstracts 31553 and 31674.

31755 (JINR-13-4454) MAGNETO-OPTICAL SYSTEM OF GAS-FILLED MASS-SEPARATOR. Karnaukhov, V. A.; Rubinskaya, L. A.; Ter-Akop'yan, G. M.; Titov, V. N.; Chugreev, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1969. 16p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The gas-filled mass separator was designed to study the short-lived products of nuclear reactions which take place in a heavy-ion beam. Its magneto-optical system was filled with a gas at a pressure of 0.1 to 10 mm of Hg. The reaction products emitted from the target irradiated by the beam reach the magnetic system in the form of ions which collide with the atoms of the gas, changing their charge and the radius of curvature of their trajectory. The correlation between the velocity and the charge of the ions may be derived from the mean radius. The properties of the magneto-optical system were checked by measuring the boundaries of the scattering field and the homogeneity of the field at the center of the magnet by means of a Hall transducer. The measurements revealed that the field intensity at the center was $H < 10$ kGauss. At higher values, the homogeneity of the field was somewhat disturbed, without affecting the operation of the magnetic separator. The optimum location of the source and of the focal plane of the mass separator was determined by means of a ^{244}Pu source. Determination of the optical properties required pulsing of the particles, changing the magnetic field by ±2% with respect to the pulse of the α particles of ^{244}Pu; this did not decrease to any noticeable extent the resolution of the spectrometer. (TTT)

31756 SELECTION OF RESPIRATORS FOR RADIOACTIVE CONTAMINANTS. Inouye, Takeichiro (Musashi Inst. of Tech., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 155-7 (1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Test results of different respirators and criteria for selection of respirators are discussed. (W.H.K.)

31757 DATA PROCESSING SYSTEMS IN NUCLEAR MEDICINE. Kashio, Eiji; Kurihara, Shigeyasu; Asahina, Kiyotaka; Fujikawa, Nobumasa (Tokyo Shibaura Electric Co., Ltd.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 377(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Data processing systems for scintiscanners, gamma cameras, and systems for dynamic function studies are very briefly discussed. (W.H.K.)

31758 RADIO SYSTEM FOR DETECTING PULSES FROM COSMIC-RAY EXTENSIVE AIR SHOWERS. Mandolesi, N. (CNR, Bologna); Palumbo, G. G. C.; Sinigalia, G.; Tomassetti, G. Nuovo Cim.; 67B: 153-66(11 Jun 1970).

A radio-receiving system for detection of radio pulses from extensive air showers was built. Such system was formed of two radio channels simultaneously triggered by a three-scintillator shower array. The first channel was fed by an array of four Yagi 30 MHz antennae. The second channel was fed by an 11-element Yagi antenna at 408 MHz. Both receiving systems are described and their sensitivity discussed as well as noise temperature. (auth)

31759 SUPERCONDUCTING MAGNETIC FLUX DETECTOR. Goodkind, J. M.; Stolfa, D. L. (Univ. of California, San Diego, La Jolla). Rev. Sci. Instrum.; 41: 799-807(Jun 1970).

A superconducting magnetic flux detector which can detect changes in flux as small as 10^{-11} G · cm^2 is now in use in a small number of low temperature laboratories. How the devices work, how they are made, how they can be used for practical measurements of magnetic susceptibilities or fields, and how they can be made even more sensitive are described. The devices can easily be used in work other than low temperature physics and should find widespread application. (auth)

31760 ELECTROSTATIC ANALYZER WITH NO FRINGE FIELD FOR MEASUREMENTS OF LOW ENERGY PARTICLES ON SPACE VEHICLES. Mariani, F. (Univ., Rome. CNR, Rome). Rev. Sci. Instrum.; 41: 807-12(Jun 1970).

An electrostatic analyzer is discussed which has no fringe field effects. The basic idea is to form the equipotential surfaces around an ideal conductor for which the Dirichlet problem can be exactly solved. It is just the case of any spherical conducting cap, in particular, any hemispherical cap: The equipotential surfaces, in the portion interesting for the trajectory of the particles, are very near to spherical surfaces so that the focusing properties of the ideal hemispherical condenser are still valid. The external surface can act as the container so that another source of perturbation of the electric field is eliminated. The computed and experimental response of the analyzer shows satisfactory agreement for several different geometrical conditions, within the limits due to the expected uncertainties. Some further ap-

plications are also mentioned in view of making simultaneous measurements in different energy bands, as well as of determining, in favorable conditions, the potential of the external electrode when it is not zero, which can be the case of an analyzer on board a satellite. (auth)

31761 9th CONFERENCE ON TUBE TECHNIQUES, NEW YORK, N. Y., SEPTEMBER 17–18, 1968. Conference Record. New York; Institute of Electrical and Electronics Engineers, Inc. (1968). 299p. $10.50. (CONF-680975).

Separate abstracts were prepared for 2 of the 9 papers presented. The remaining 7 papers were not within the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 31762 and 31763.

31762 DEVELOPMENT OF HIGH TEMPERATURE THYRATRONS FOR LARGE NUCLEAR ELECTRICAL SPACE POWER SYSTEMS. Jones, N. D. (General Electric Co., Schenectady, N. Y.). pp 137–44 of 9th Conference on Tube Techniques, New York, N. Y., September 17–18, 1968. New York; Institute of Electrical and Electronics Engineers, Inc. (1968).

See CONF-680975.

Discussion of the current status of the development of high-temperature, high-power, gas diodes and thyratrons for large nuclear electrical space power systems. The feasibility of operating ceramic thyratrons and rectifiers for extended periods at tube temperatures of 700°C has been demonstrated. The tube envelope structure has performed well, and the extensive use of graphite to minimize spurious electron emission has proved effective. The use of thallium as a working fluid has been very successful. The usefulness of matrix cathodes in gaseous discharge devices where tube operating requirements are very severe has been demonstrated. In general, these tubes promise reliable, long-life operation in power systems which are required to operate at very high temperatures. (auth)

31763 NONELECTRIC CATHODE HEATING. Conway, E. C. (General Electric Co., King of Prussia, Pa.); Kelley, M. J.; Wilmarth, R. W.; Beggs, J. E. pp 191–5 of 9th Conference on Tube Techniques, New York, N. Y., September 17–18, 1968. New York; Institute of Electrical and Electronics Engineers, Inc. (1968).

See CONF-680975.

A description of a vacuum tube which has been constructed to obtain more efficient utilization of heat than is provided by thermoelectric or thermionic devices is given. The vacuum tube is such that its cathode is directly heated by a radioisotope source external to the tube. The tube design incorporates a heat pipe to provide almost isothermal transfer of heat from the external source to the cathode. Test results demonstrate operation with an external electrical heater and a radioisotope heat source. (auth)

31764 DIGITAL DYNAMIC STUDIES WITH A GAMMA CAMERA. Ronai, P. M. (Inst. of Medical and Veterinary Science, Adelaide). Australas. Bull. Med. Phys. Biophys.; No. 43, 4–11(Mar 1970). (CONF-690830-3).

From Ninth Annual Meeting of Physics in Medicine and Biology, Perth, Australia.

A scintillation camera was modified for dynamic digital studies by the addition of dual analogue-to-digital converters, a 1600 channel analyzer and a fast magnetic tape system. Cerebral blood flow studies were carried out using an intravenous injection of 10 to 15 mCi ^{99m}Tc as pertechnetate. Dual regions of interest were selected, one corresponding to each hemisphere, and perfusion curves plotted for each region of interest. (Australia)

Radiation Effects on Instruments and Instrument Components

Refer also to abstract 32910.

31765 (N–70–14572) STUDY OF INTERACTION OF LOW DOSE POWER SOURCE RADIATION FIELDS WITH SELECTED SPACE SCIENTIFIC INSTRUMENTS. Quarterly Progress Report. Haverfield, A. J.; Endres, G. W. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 12 Dec 1969. Contracts NAS7-100; JPL-952559. 23p. (NASA-CR–107447; Y–49607). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

The electronic setup for the scintillation neutron spectrometer is given in some detail with a complete block diagram. Measurements taken with the spectrometer before component failure are discussed. Preliminary measurements with the totally depleted surface barrier detectors are shown along with the calibration results obtained with a Po-210 alpha source. Details of several Be(d,n) neutron exposures are shown with neutron energy yields as a function of deuteron bombardment energy. (auth) (USGRDR)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 31362 and 32193.

31766 (UCRL–19785) GENERATOR-PRODUCED ^{81m}Kr FOR DYNAMIC STUDIES OF THE LUNGS AND HEART WITH THE SCINTILLATION CAMERA. Yano, Y.; McRae, J.; Anger, H. O. (California Univ., Berkeley. Lawrence Radiation Lab.). Apr 1970. Contract W-7405-eng-48. 11p. (CONF-700517-2). Dep. CFSTI.

From Preparation and Control of Radiopharmaceuticals Conference, Vienna, Austria.

Krypton-81m is obtained in multimillicurie amounts from its cyclotron-produced parent isotope 4.7-hr ^{81}Rb. The 13-sec ^{81m}Kr daughter decays by isomeric transition and emission of a monoenergetic 190-keV γ ray which is 35% internally converted. Dynamic perfusion studies are done with ^{81m}Kr by injecting the sterile saline-^{81m}Kr solution intravenously and taking 1- to 3-sec exposures with the scintillation camera. Blood flow through the right heart, pulmonary arteries, and lungs is visualized. Krypton-81m is obtained as a gas from the same generator system by eluting the dry resin column with air. This mixture of ^{81m}Kr and air is inhaled by the patient to provide ventilation and exchange studies of the lungs. Five to six mCi of ^{81m}Kr can be given every few minutes to obtain different views or to repeat studies of patients. The high photon yield, moderate γ-ray energy for scintigraphy, and short half-life (which keeps the radiation dose to a low level) make ^{81m}Kr an ideal radionuclide for dynamic studies with the scintillation camera. (auth)

Basic Processes

Refer also to abstracts 31255, 31704, 31899, 32051, 32082, 32093, and 32115.

31767 (CNEA–255) PREPARATION OF ^{125}I- AND ^{131}I-INSULIN OF HIGH SPECIFIC ACTIVITY IN CNEA. Albani, Hugo; Cresto, Juan C.; Mitta, Aldo E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1969. 10p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

Insulin of high specific activity was prepared by the Hunter and Greenwood technique. A product was obtained with less than 5% denaturalization, normal immunological uptake, and specific activity of about 250 mCi/mg in 70% of the experiments. The preparation was done by fixing ^{125}I and ^{131}I in the insulin molecule in neutral medium by means of radioactive NaI and cloramina T and reducing the oxidant excess with a solution of sodium metabisulfite. (tr-auth)

31768 (IAN-A–6) EFFECT OF LIME ON THE ABSORPTION OF PHOSPHOROUS ^{32}P RELATED TO FERTILIZATION IN THE GROWING OF RICE. Perdomo C., M. A.; Lopez M., J. I. (Instituto de Asuntos Nucleares, Bogota (Colombia). Seccion de Aplicacion de Radioisotopos a la Agricultura). 1969. 29p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

A study was made in the cultivation of rice with the object of investigating the effect of lime on the absorption of P from the fertilizer and on the yields. The results showed that the best source of P with respect to the yield is the Thomas volcanic ashes; however the addition of lime when this source of P is used in doses of ½, 1, and 1½ tons per hectare does not increase the yield. It was observed that the use of lime in doses used with superphosphate increase the yield to a highly significant degree with respect to the test plantings. When superphosphate without lime is used in these soils, the yields are similar to the test plantings. The results show that lime in the doses used has no effect on the absorption of P from fertilizer. The results suggest that the better behavior of the Thomas volcanic ashes is due to other factors than the P and lime. (tr-auth)

31769 (IAN-A–7) STUDY OF THE RADICLE DEVELOPMENT OF THE POTATO BY MEANS OF ^{32}P. Gomez R., J. E.; Perdomo C., M. A. (Instituto de Asuntos Nucleares, Bogota (Colombia). Seccion de Aplicacion de Radioisotopos a la Agricultura). 1969. 35p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

The extension and rate of root growth was studied in the Diacol Sumapaz variety of potato. The study was made by placing small quantities of triple superphosphate solution, labeled with ^{32}P, at lateral intervals of 15, 30, 45, 60, 75, and 100 cm and vertical intervals of –15, –5, 5, 15, 30, 45, and 60 cm. The study was done in the fields and the presence of activity in the foliage, determined with a G–M counter, was taken as an indication that the root had reached the site of the placement of the tracer material. The data on the presence of activity was taken every seventh day. The results indicate that the growth of the roots in the vertical direction is 2.1 cm/day during the three weeks following germination, and in the same period a depth of 45 cm. The growth in the lateral direction was slower, 0.97 cm/day, but its development was prolonged until the eleventh week to reach 75 cm. (tr-auth)

31770 (IAN-B–5) BIOCHEMICAL AND KINETIC PARAMETERS USING SAMPLES OF RADIOACTIVE IODINE IN A GROUP OF PERSONS IN THE DOMAIN OF A GOITER REGION OF COLOMBIA. Kutka, M.; Posada, J. R.; de Betancourt, I. L. (Instituto de Asuntos Nucleares, Bogota (Colombia). Seccion de Medicina y Biologia). 1969. 25p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

The biochemical and kinetic parameters of iodine uptake were studied in two groups of people residing in Colombia. The first group was from a small village with endemic goiter, consisting of both sexes in ages from 11 to 75 years, and the second group consisted of college students of both sexes attending local colleges. Conventional and special biochemical and radioisotopic methods were used to study the uptake of the radioactive iodine. No significant differences were found between the two groups. The PBI value corresponds to that of regions without endemic goiter. The results indicate, however, in the first approximation, the presence of disturbances in the metabolism of proteins by an important factor. It is difficult to determine if the basis for these differences are the result of endogenic or exogenic factors. (J.S.R.)

31771 (SAN–733-3) EFFECT OF CONTINUOUS GAMMA IRRADIATION ON GROWTH OF VIRUSES IN TISSUE CULTURE SYSTEMS. Final Report, May 15, 1969–May 14, 1970. Quilligan, J. J. Jr.; Boche, Robert D. (Loma Linda Univ., Calif.). Contract AT(04-3)-733. 22p. Dep. CFSTI.

A new method for quantitative hemadsorption based on γ counting of ^{51}Cr-labeled red blood cells was developed. It is highly correlated with plaque counts, R = .96 or greater, and can therefore be substituted for them. The method was applied to the determination of influenza antibody, interferon, inhibition of virus growth by poly IC, and the effects of γ irradiation on virus growth in cultures. The method was shown to be exceedingly sensitive. The continuous γ irradiation of tissue cultures increased the yield of virus somewhat, although the concomitant effects on the growth of the cells tended to obscure the result. Single exposure to γ or β rays had little or no effect on the yield of influenza virus in tissue culture. The L-amino acid requirements of influenza viral hemagglutinin were investigated. A preliminary feasibility study directed toward the development of a safe Rubella vaccine for pregnant women by γ irradiation of the virus showed considerable promise. (auth)

31772 (UCRL–19766) PREPARATION AND CONTROL OF ^{68}Ga RADIOPHARMACEUTICALS. Yano, Y. (California Univ., Berkeley. Lawrence Radiation Lab.). Apr 1970. Contract W-7405-eng-48. 11p. (CONF-700517-1). Dep. CFSTI.

From Preparation and Control of Radiopharmaceuticals Conference, Vienna, Austria.

Development of the ^{68}Ge–^{68}Ga generator and its applications in nuclear medicine are reviewed. The preparation of radiopharmaceuticals labeled with ^{68}Ga is described. Clinical and animal studies with ^{68}Ga as ^{68}Ga-EDTA for brain tumor localization, ^{68}Ga-citrate for uptake in bone, and ^{68}Ga-ferric oxide colloid for bone marrow scanning are presented. The preparation of ^{68}Ga-polymetaphosphate-Mg-polymetaphosphate for kidney scanning and ^{68}Ga-chromic phosphate for liver scanning is described. The radiation dose and toxicity of these radiopharmaceuticals are given. Procedures are suggested for maintaining and testing the sterility and apyrogenicity of ^{68}Ga elutions from the generator. The future usefulness of ^{68}Ga for scanning in nuclear medicine is evaluated on the basis of improved radiopharmaceuticals and greater availability of instrumentation for imaging with positron emitters. (auth)

31773 USE OF RADIOISOTOPES IN AGRICULTURAL RESEARCH. Malavolta, E.; Crocomo, O. J.; Neptune, A. M. Louis; Reichardt, K.; Cervellini, A. (Univ. de Sao Paulo, Piracicaba, Brazil). An. Acad. Brasil. Cienc., 39: Suppl., 39–64(Dec. 31, 1967). (In Spanish).

From Symposium on Peaceful Uses of Atomic Radiation, Rio de Janeiro, Brazil. See CONF-670709.

The results of studies made in the past three or four years at the University of Sao Paulo on the use of radioisotopes in agricultural research are summarized. Radioisotopes were used to study soil physics and soil fertility. Tracer techniques were used to study vegetable nutrition and the uptake of fission products by plants. Soil physics studies included determination of apparent density and humidity of soil using γ radiation, labeling of soil aggregates stable in water, determination of soil humidity by neutron attenuation, and evaporation from soil and its control. Soil fertility studies included determination of the cation exchange capacity of different soils and clays and a determination of the availability of phosphorus from the soil and from fertilizers. The absorption and incorporation of ions were studied with tracer techniques. The uptake of Sr and Cs by plants and the effect of various factors was investigated. (J.S.R.)

31774 RADIOAUTOGRAPHIC AND RADIOCHEMICAL ANALYSIS OF POSTNATAL COLLAGEN FORMATION IN MOUSE DERMAL SKIN. Seiguer, A. C.; Gonzalez Cadavid, N.; Paz, M.; Mancini, R. E. (Univ., Buenos Aires). Ann. Histochim., 12: 363-77(Oct.-Dec. 1967).

A radioautographical and radiochemical study of collagen during postnatal maturation of mouse dermal tissue was made. Densitometric quantitation of radioactivity induced by (^{14}C)-proline in the dermis showed that it decreased parallel with age from 2 to 70 day old mice. At all ages, the uptake reached a peak at 24 hours and diminished from 3 days onward. Cytologically both proline and glycine appeared predominantly in the fibroblast during the first hours and then in the intercellular spaces where they remained about two weeks. This radioautographic picture persisted unchanged when the slides were pretreated with elastase or hyaluronidase, whereas it almost disappeared when collagenase or neutral and citrate saline solutions were used. This effect was more marked in the dermis of younger animals. Radiochemically a decrease with age of hydroxyproline specific activity in all collagen fractions appeared after injection of (^{14}C) proline. The radioactive hydroxyproline in neutral salt soluble collagen fell from 2 to 24 hours at all ages but was remarkable in younger mice. Conversely it increased significantly in the insoluble collagen and slightly in the citrate soluble fraction. It is deduced that the rate of collagen metabolism parallels the postnatal maturation of dermal tissue, being more active in younger animals and coinciding with the period of pronounced formation of reticulin fibers. (auth)

31775 DISSOCIATION OF HISTAMINE RELEASE AND $^{22}Na^{+}$ UPTAKE IN RAT MAST CELLS EXPOSED TO COMPOUND 48/80 IN VITRO. Slorach, Stuart A.; Uvnaes, Boerje (Karolinska Institutet, Stockholm). Acta Physiol. Scand., 76: 201-12(May-June 1969).

The relation between ^{22}Na uptake by, and histamine release from, rat mast cells exposed to compound 48/80 in vitro was investigated. Time course studies showed that ^{22}Na uptake and histamine release both begin after a latent period of about 5 sec but, whereas histamine release is complete after ~30 sec, ^{22}Na uptake is not maximal until after 10 min. Assuming that ^{22}Na and ^{23}Na are taken up similarly, it was calculated that the quantity of ^{23}Na taken up was insufficient to replace the amount of histamine released if an intracellular exchange of these 2 ions was involved. It was concluded that intracellular exchange of sodium for histamine does not play a significant role in histamine release induced by compound 48/80. The large increase in ^{22}Na uptake by mast cells exposed to compound 48/80 can be prevented by pretreating the cells with N-ethyl maleimide or ninhydrin, which also inhibit the histamine release. The histamine liberator d-tubocurarine also increased the net ^{22}Na uptake by mast cells but another releaser, n-decylamine, which releases histamine by lysis of the cell membrane, did not. (BBB)

31776 RADIOIMMUNOASSAY OF PROTEIN HORMONES. Imura, Hiroo; Matsukura, Shigeru; Sakurai, Hideo; Ikeda, Masaki; Kato, Yuzuru; Yawata, Mikio; Kusakabe, Tsunesuke; Fukase, Masaichi; Torizuka, Kanji (Kyoto Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 398-400(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Results are reported from basic studies on radioimmunoassay of human growth hormone (HGH), human thyrotropic hormone (TSH), adrenocorticotropic hormone (ACTH), insulin, and glucagon in order to clarify the validity of radioimmunoassay of these hormones. Applications of radioimmunoassay in the diagnosis of various diseases are discussed briefly. (C.H.)

31777 MEASUREMENT OF PLASMA PROGESTERONE AND 17 alpha-HYDROXYPROGESTERONE BY COMPETITIVE PROTEIN BINDING. Yoshimi, Teruya; Kono, Tsuyoshi (Kyoto Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 404-6(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A sensitive in vitro radioisotope method is described for the measurement of progesterone and 17α-hydroxyprogesterone in samples of human blood plasma. The method uses the principle of competitive protein binding with tritium as the tracer. (C.H.)

31778 WHOLE BODY ACTIVATION AUTORADIOGRAPHY. Matsuoka, Osamu; Kashima, Masatoshi; Joshima, Hisamasa; Noda, Yutaka (National Inst. of Radiological Sciences, Chiba, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 445-7 (1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Developments in whole-body serial section autoradiography for studies of the tissue distribution of non-radioactive materials in laboratory animals are described. Freeze-dried whole-body sections of the animals were exposed to neutrons beams to activate the target material, and autoradiograms were prepared by placing the activated specimens in contact with x-ray films. The target elements administered by inhalation or injection included Au, Mn, Hg, Pr, and Eu. The radioactivity in the activated sample was also measured using a GM counter, by $\beta-\gamma$ spectrometry, and by scintillation detector. Difficulties associated with interference from induced radioactivities in naturally occurring elements in the specimen are discussed. (C.H.)

31779 CYTOKINETIC ANALYSIS OF HUMAN CANCERS IN VIVO USING ^{3}H-THYMIDINE AUTORADIOGRAPHY BY LOCAL CUMULATIVE LABELING TECHNIQUE. Ashihara, T. (Kyoto Prefecture Univ.); Nagane, R.; Kubo, Y.; (and others). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 451-3(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The development of autoradiographic methods for the study of the kinetics of cell proliferation in human squamous cell carcinomas following the local administration of ^{3}H-thymidine is reviewed. Labeling indices counted in flash label autoradiographs of about 50 patients varied from 15% to 30%. The potential of the method for predicting the growth rate of tumors is discussed. (C.H.)

31780 STUDIES ON THE DISTRIBUTION OF LABELLED DRUGS IN ANIMALS BY MEANS OF WHOLE BODY AUTORADIOGRAPHY. Sato, Yoshishige (Tanabe Seiyaku Co., Ltd., Japan); Takahashi, Tadao; Sakumu, Mari; Hirata, Akira. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 462-4(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Developments in whole-body serial section autoradiography for studies of the tissue distribution of radioisotope-labeled drugs in experimental animals are reviewed. Examples using ^{14}C-, ^{3}H-, or ^{35}S-labeled drugs administered in various ways to mice, rats, guinea pigs, monkeys, and chickens are reported. (C.H.)

31781 TRITIUM LABELING AND METABOLISM OF A NEW PRESERVATIVE (2-(2-FURYL)-3-(5-NITRO-2-FURYL)-ACRYLAMIDE) IN MICE. Takase, Akira (Inst. of Public Health, Tokyo); Izumo, Yoshiro; Nishikado, Mamoru; Kawamura, Arimichi. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 465-7(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A preservative used for meat or fish sausages and some other foods in Japan is (2-(2-furyl)-3-(5-nitro-2-furyl)-acrylamide (AF-2)). This compound is sometimes used in combination with γ radiation for the processing of foods. The metabolism of AF-2 was studied in mice using tritium-labeled AF-2. Methods used for the preparation of the labeled compound are described and data are presented on the absorption of AF-2 from the GI tract following ingestion, distribution in tissues, and excretion in feces and urine. (C.H.)

31782 A METHOD FOR THE MEASUREMENT OF DIGESTIBILITY IN FISH USING RADIO-CHROMIC OXIDE. Takase, Akira (Inst. of Public Health, Tokyo); Kawamura, Arimichi; Izumo, Yoshiro. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 468-70(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The uptake of nitrogen from the diet by fish was studied in gold-

fish using $^{51}Cr_2O_3$ as a tracer for nitrogen with radiometric analysis of feces. The method was found to be more accurate than chemical methods for measuring nitrogen metabolism in fish. (C.H.)

31783 A BIOASSAY METHOD FOR THE EVALUATION OF RIVER WATER POLLUTION USING SHELLFISH'S ABILITY ON THE UPTAKE OF RADIOACTIVE PARTICLES. Takase, Akira (Inst. of Public Health, Tokyo); Uchiyama, Masuo; Kawamura, Arimichi; Izumo, Yoshiro. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 471-3(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The effects of water pollution on food uptake and metabolism by shellfish was studied in clams and oysters using Escherichia coli labeled with ^{90}Y, ^{203}Hg, or ^{110}Ag or ^{131}I-labeled protein aggregates as tracers. The method was found to be simple and easier to use than conventional methods. Results of a study conducted over a six-months period are summarized. It was concluded that pollution of river water has an adverse effect on the biological activity and survival of clams and oysters. (C.H.)

31784 THE BBD–RISA COMPLEX AS A DIAGNOSTIC AND POTENTIALLY THERAPEUTIC AGENT. Penn, H. S. (Univ. of California, Berkeley). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 625-7(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A complex of ^{131}I-labeled serum albumin and bovine bile derivative (90 to 95% taurocholic acid) gave good results for scanning bones, liver and the intestinal tract for tumor localization. The preferential localization of the complex was ascribed to the presence of the bile derivative and reaction mechanisms involved are postulated. Possible therapeutic uses of the complex are suggested. (C.H.)

31785 IN-VITRO TESTING: T-4. Konneker, W. R. (Mallinckrodt Nuclear Corp., St. Charles, Mo.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 635-42(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The current status of in vitro radioisotope tracer methods for testing thyroid function is reviewed. The diagnostic advantages and disadvantages of three methods are discussed. These include measurements of the hormonal iodine content of serum proteins, the quantity of serum iodine extractable with butyl alcohol, the degree of unsaturation of proteins that transport thyroid hormones, and measurement of levels of non-protein-bound thyroid hormone in blood serum. (C.H.)

31786 PRINCIPLES AND METHODOLOGIC CONSIDERATIONS IN RADIOIMMUNOASSAY. Berson, Solomon A.; Yalow, Rosalyn S. (Veterans Administration Hospital, New York. Mount Sinai School of Medicine, New York. Mount Sinai Hospital, New York). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 343-51(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The principle of radioimmunoassay methodology is reviewed. The sensitivity of the method for the measurement of hormones in blood serum is discussed. (C.H.)

31787 STABILITY OF TRITIUM COMPOUNDS UNDER BIOLOGICAL CONDITIONS. Evans, E. Anthony (Radiochemical Centre, Amersham, Eng.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 652-61(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The stability of tritium-labeled organic compounds used as tracers for biological studies is discussed. It is pointed out that the stability is related to the position of the tritium atoms in the tracer compound. Biochemical reactions that influence the stability and behavior of tritium atoms in various types of organic molecules are discussed. (C.H.)

31788 MACROAUTORADIOGRAPHY OF THE LARGER LABORATORY ANIMALS. Kalberer, F. (Sandoz Ltd., Basel). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 662-8(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Developments in whole-body serial section autoradiography for studies of the tissue distribution of radioisotope-labeled compounds in experimental animals are reviewed. The size limit of animals for preparing whole-body sections with the microtome is reached at a body weight of approximately 250 g, however a circular saw permits sections suitable for autoradiographic studies from whole animals with a body weight of approximately 2 kg. The use of frozen whole-body sections of rabbits, rats, cats, and monkeys for the preparation of autoradiograms is described. (C.H.)

31789 ELECTRON MICROSCOPIC AUTORADIOGRAPHY IN BIOLOGICAL USE IN JAPAN. Mizuhira, Vinci (Tokyo Medical and Dental Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 691-6(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Developments in electron microscope autoradiography for use in tracer studies of metabolism are reviewed. Methods for sample preparation and the characteristics of various nuclear emulsions are discussed. (C.H.)

31790 RADIOISOTOPE USES IN DRUG MAKERS: WHOLE BODY AUTORADIOGRAPHY. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 859-84(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Tracer techniques using ^{3}H-labeled compounds and whole-body autoradiography for studies on the tissue distribution of drugs in experimental animals are discussed. Methods for the preparation of autoradiograms of serial sections of different thicknesses of cats, dogs, and monkeys are described. (C.H.)

31791 RADIOIMMUNOASSAYABLE ACTH IN DEXAMETHASONE NONSUPPRESSIBLE CUSHING'S SYNDROME. Rayyis, Suad S.; Bethune, John E. (Univ. of Southern California, Los Angeles. Los Angeles County/Univ. of Southern California Medical Center, Los Angeles). J. Clin. Endocrinol. Metab., 29: 1231-7(Sept. 1969).

Radioimmunoassayable serum ACTH has been measured in a patient with Cushing's syndrome due to bilateral adrenal hyperplasia showing failure of dexamethasone suppression of plasma and urinary steroids with up to 32 mg of dexamethasone/day. Plasma ACTH was consistently elevated and showed an abnormal diurnal pattern which altered with increasing doses of dexamethasone. On extremely high doses of dexamethasone, urinary 17-ketogenic steroid excretion doubled over base line at a time when ACTH seemed to lose its diurnal pattern and remain at a relatively high level. The patient's ACTH response to metyrapone was similar to that of a patient with suppressible Cushing's syndrome and adrenal hyperplasia. The intravenous infusion of hydrocortisone produced a dramatic fall in serum ACTH concentration not noted during the administration of dexamethasone. The study suggests a derangement in the feedback receptor for dexamethasone as the cause of this anomalous response of ACTH and adrenal steroids during dexamethasone administration. (auth)

31792 RADIOTRACER STUDY OF PREDATORS ON DISTANTIELLA THEOBROMA (DISTANT) (HEMIPTERA: MIRIDAE). Marchart, H. (Ghana Academy of Sciences, Tafo). pp 3-15 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

A method for labeling the cocoa capsid Distantiella theobroma (Distant) with ^{32}P in sucrose solution is described. The label was excreted with a biological half-life of six days. When taken up from a labeled natural substrate (cocoa pods) the ^{32}P activity in the insect attained an equilibrium value after nine days and was excreted with the same half-life. Labeled larvae in the field were exposed to the natural predator population, which was sampled by pyrethrum knockdown after 48 hours. None of the predators identified is specialized as a capsid predator. The broad range of predatory species reflects the high species diversity within the tropical forest zone, which is considered to be an important factor in integrated capsid control. (auth)

31793 USE OF RADIOACTIVE GOLD, ^{198}Au, TO STUDY THE RADIUS OF ACTION OF COLONIES OF BUMBLE-BEES (BOMBUS SP.) WITH A VIEW TO POLLINATION OF CULTIVATED PLANTS. Lecomte, J.; Pouvreau, A. (Insectes Sociaux, Bures-sur-Yvette, France). pp 17-21 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In French).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

It is generally very easy to label a colony with a radioisotope, taking advantage of the constant exchange of food between individuals. Bumblebees, although living in a colony, do not engage in direct exchange, but it has been shown that continual transfer takes place through the honey cells (secondary trophallaxia). In these conditions a bumblebee colony can be labeled as easily as a hive of bees. Gold-198 was successfully used for the tests,

which enabled us to obtain important and unpublished information on the behavior of workers in bumblebee colonies situated close to fields of leguminous crops, with a view to enhancing grain production. Questions that have been investigated by this method include the time required to become familiarized to a new site, fixation on a particular species of plant, the radius of action and the determinate character of the flight paths and the honey-gathering sectors. (auth)

31794 UPTAKE OF ISOTOPICALLY LABELLED INSECTICIDES IN RELATION TO TEMPERATURE AND OTHER PHYSICAL FACTORS. Cutkomp, L. K. (Univ. of Minnesota, St. Paul). pp 179-85 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Labeling insecticides with isotopes provides a sensitive method for investigating their uptake in relation to unusual toxic response in insects. The uptake of ^{14}C-DDT was traced at three different exposure temperatures with mosquito larvae, Aedes aegypti. In addition, explanations of different toxicity responses related to the insect densities were studied with ^{14}C-DDT on Tribolium confusum, and with tritium-labeled nicotine on mosquito larvae. In the latter study, the labeled nicotine produced greater toxicity which was apparently due to a more stable chemical bonding resulting in failure of the insects to metabolize the isotopically labeled chemical as readily as natural nicotine. (auth)

31795 LABELING OF MOUSE ALLOANTIBODY WITH TRITIATED DL-ALANINE. Haemmerling, U.; Shigeno, N.; Old, L. J.; Boyse, E. A. (Sloan-Kettering Inst. for Cancer Research, New York). Immunology; 17: 999-1006(Dec 1969).

Radioiodination is not a satisfactory method of labeling mouse antibody, which is peculiarly susceptible to destruction during the process of iodination. An alternative that causes very little loss of antibody is the attachment of a tritium-labeled amino acid to mouse γG by peptide linkage. This is accomplished by reaction of γG with DL-alanine N-carboxy, anhydride under mild conditions. The method is applicable to estimation in vitro of the relative amounts of H-2 antibody absorbed by viable cells, and of the relative amounts of H-2 antigen on viable cells. Non-specific uptake is virtually eliminated by: prior absorption of the labeled product in vivo, pre-incubation of the cells in 20 percent foetal bovine serum and its inclusion in the suspending medium, and performance of absorption procedures in the cold. (auth)

31796 AUTORADIOGRAPHIC DEMONSTRATION OF DNA SYNTHESIS IN SELECTED EPITHELIAL TISSUES IN MALE RATS. England, Marshall C. Jr.; Burke, George W. Jr. (Virginia Commonwealth Univ., Richmond). J. Dent. Res.; 48: 1219-23(Nov-Dec 1969).

Eleven white male rats received intravenous injections of thymidine ^{3}H at a dose rate of 1 μCi/gm body weight. The rats were killed at 4-hr intervals over a 24-hr period. Epithelial specimens from the hard and soft palate, cheek, skin, and tail were subjected to autoradiography. The results confirm prior data from liquid scintillation studies, which showed a maximal DNA synthesis at 4:30 to 8:45 a.m. and minimal synthesis at 3:40 to 8:30 p.m. (auth)

31797 UTILIZATION OF URINARY Na/K RATIOS AND TRACER METHODOLOGY FOR THE DETECTION OF STRESS. Stratmeyer, M. E.; Shaw, S. M.; Christian, J. E. (Purdue Univ., Lafayette, Ind.). Radiochem. Radioanal. Lett.; 2: 285-9(27 Dec 1969).

Alteration in urinary Na/K ratios as a result of cold stress was detected by a radiotracer procedure in which ^{24}Na and ^{42}K were simultaneously determined in the urine. Adrenal ascorbic acid levels were employed for confirmation of a stressed condition. The radiotracer technique should provide a sensitive analytical method for the detection of stressors and/or a state of stress. (auth)

31798 PROBLEMS ASSOCIATED WITH THE USE OF LABELLED MOLECULES IN BIOLOGY AND MEDICINE. Feinendegen, L. E. (Kernforschungsanlage, Juelich, Ger.). pp 1-15 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

A general review is given on problems associated with the use of labeled molecules in the life sciences. Three areas of interest were selected for discussion concerning: (a) the tracer molecule; (b) aspects of cellular metabolism; and (c) the toxicity of the incorporated isotopes. In respect of the tracer molecule, specificity of labeling (especially that with tritium), radiochemical purity, biological stability (particularly in the case of tritiated precursors) and kinetic isotope effects are discussed. The paper also covers various aspects of cellular metabolism, such as the importance of cellular specificity of enzymes, the size of the "soluble pool," and control of pool equilibrium, as well as the implication of cell proliferation on isotope content, the relationship between cell cycle and radiosensitivity, factors influencing the duration of the cell cycle, problems of precursor availability and rate of cellular incorporation—including the contribution from precursor re-utilization—and the importance of the geometry of the incorporated precursor. The discussion of the toxicity of incorporated isotopes gives an introduction to transmutation effects, aside from radiation effects and considers the transmutation effects of tritium, ^{14}C, ^{35}S, and ^{32}P. Attention is called to the possible biological implications of the Auger effect. (auth)

31799 COMPARISON OF 2 AUTORADIOGRAPHIC METHODS BASED ON THE USE OF TRITIATED THYMIDINE TO MEASURE THE DURATION OF THE S PHASE (PHASE OF DEOXYRIBONUCLEIC ACID SYNTHESIS) AND INTERPHASE OF CELLS FROM DIFFERENT MOUSE TISSUES. Galand, P. (Univ. Libre, Brussels). Arch. Biol. (Liege); 78: 167-91(1967). (In French).

The use of two autoradiographic techniques to measure the duration of the generation cycle and of the DNA-synthesis phase (S phase) is compared. The techniques used involve counting the number labeled mitoses and a double-labeling method, both techniques making use of radioactive thymidine. Amounts of 1 to 10 μC of ^{3}H-thymidine were employed. Several tissues of the mouse were studied: liver parenchyma; epithelium of the renal tubules; pharyngeal epithelium; epithelium of the crypts in the duodenum, jejunum, ileum, and colon; epidermis; pancreatic cells (exocrine); and thyroid follicular cells. Comparison of the results showed, in agreement with earlier conclusions, that both techniques give similar values for duration of the S phase. It was observed, moreover, that the same is true for the generation time. Values of this time are given for tissues for which data are lacking in the literature. For results of both methods to be applicable, it is necessary to obtain relatively brief labeling of the cells. Only cells that are actively engaged in DNA synthesis at the moment of ^{3}H-thymidine injection must appear labeled in the autoradiographs. Biochemical measurements showed that this condition is satisfactorily realized after intraperitoneal injection of thymidine into the mouse. Comparison between such determinations and the autoradiographic observations indicated that after intraperitoneal injection of the precursor the cells in S phase, and only those cells, constitute a storage pool of labeled DNA precursors. This pool is subsequently used to label the DNA, even when, as reported earlier, the labeled thymidine has practically disappeared from the plasma. Due to its main advantages (requirement of only a single tissue sample, shortness of experimental procedure), the double labeling technique, as described by Maurer et al. in 1965, is recommended for clinical investigations using human biopsies incubated in vitro. (BBB)

31800 EFFECT OF CIRCULATING FRAGMENTS OF ANGIOTENSIN II ON RADIOIMMUNOASSAY IN ARTERIAL AND VENOUS BLOOD. Cain, M. D.; Catt, K. J.; Coghlan, J. P. (Monash Univ., Melbourne. Prince Henry's Hospital, Melbourne. Univ. of Melbourne). J. Clin. Endocrinol. Metab.; 29: 1639-43(Dec 1969).

Paper chromatography of arterial and venous blood extracts allowed the content and distribution of angiotensin II and related immunoreactive substances to be determined by radioimmunoassay; methodology is described. In all chromatographic results on arterial blood extracts, the predominant area of immunoreactive material was localized at the angiotensin II position; 85 ± 9 (SD)% of the total reactivity was in this predominant area. In contrast, venous blood extracts revealed reactive material at the angiotensin II position contributed only 28 ± 6 (SD)% of the total immunoreactivity. It was concluded that results indicated that measurement of angiotensin II by radioimmunoassay may considerably overestimate the true venous content of the octapeptide, whereas values obtained for arterial blood content are close to the true level. (C.O.)

31801 /sup 99m/Tc-IRON HYDROXIDE AGGREGATES. EVALUATION OF A NEW LUNG-SCANNING AGENT. Davis, Michael A. (Harvard Medical School, Cambridge, Mass. Peter Bent Brigham Hospital, Boston). Radiology; 95: 347-52(May 1970).

^{99m}Tc-iron hydroxide aggregates were prepared by a simple and reproducible chemical procedure taking from five to ten minutes. Studies in mice indicated that 88% of the intravenously injected radioactivity is trapped by the lungs with a radiation dose to the lungs of about 0.15 Rad/mCi administered. With a dose of

3 mCi, 600,000 counts are collected in two to four minutes with the Anger camera. Toxicity testing of the aggregates in mice has shown no untoward effects. The aggregates were used successfully in patients in diagnosis of lung disease, and clinical examples are reported. (auth)

31802 SANDWICH SOLID PHASE RADIOIMMUNOASSAYS FOR THE CHARACTERIZATION OF HUMAN IMMUNOGLOBULINS SYNTHESIZED IN VITRO. Salmon, Sydney E.; Smith, Beth A. (Univ. of California, San Francisco). J. Immunol.; 104: 665-72 (Mar 1970).

This report describes a sensitive, simple and rapid direct-binding solid phase sandwich radioimmunoassay for measurement of intrinsically labeled immunoglobulins synthesized in vitro. With the direct technique, small volumes of labeled tissue culture supernatants or cell sonicates can be placed directly in the sandwich assay tubes and, after a short incubation and washing, the bound specific antigen can be counted. This new direct assay complements the previously described sandwich inhibition radioimmunoassay for immunoglobulin quantitation. With the use of both techniques on the same samples, detailed quantitative characterization of cellular synthesis, assembly and secretion of immunoglobulins can be obtained under a variety of circumstances. The quantity, absolute specific activity and antigenic composition of immunoglobulins synthesized in vitro can be determined routinely with the application of the two sandwich techniques. A series of experiments on plasma cells that synthesize monoclonal IgG illustrate applications of the methods. The sandwich techniques are applicable to the detection of unlabeled or labeled immunoglobulins in the nanogram to microgram range and are suited to studies of in vitro immunoglobulin synthesis where such sensitivity and specificity are required. (auth)

31803 LIGHT-DEPENDENT COCCOLITH FORMATION IN THE TWO FORMS OF COCCOLITHUS PELAGICUS, WITH REMARKS ON THE ^{14}C ZERO-THICKNESS COUNTING EFFICIENCY OF COCCOLITHOPHORIDS. Paasche, E. (Univ. of Oslo). Arch. Mikrobiol.; 67: 199-208(10 Jul 1969).

The merits of two ^{14}C methods were studied in the marine plankton alga Coccolithus pelagicus for measuring coccolith formation and photosynthesis in coccolithophorids. The first method was based on measurements of ^{14}C radioactivity of cells on membrane filters before and after acid treatment. The second method involved a conversion of ^{14}C in coccoliths or whole cells to $BaCO_3$ prior to counting. The life cycle of this species embraced two widely different coccolithophorid types. These types were large, non-motile cells with relatively few and very heavy coccoliths, and somewhat smaller, motile cells with numerous, delicate coccoliths. The coccoliths of the non-motile form, and those of C. huxleyi and Cricosphaera were heterococcoliths, where the faces and angles of the constituent calcite crystals were largely suppressed, whereas those of the motile form were holococcoliths, in which the crystals retained their ordinary crystallographic shape. It was observed in determinations of photosynthetic or total ^{14}C by the first method that the count rate produced by a given amount of ^{14}C was 30 to 40% lower in the nonmotile and motile forms of C. pelagicus than in C. huxleyi. There was no similarly great discrepancy in determinations of coccolith ^{14}C. Light-dependent coccolith formation was demonstrated in both forms of C. pelagicus. The nonmotile form deposited several times more ^{14}C in its coccoliths than it assimilated photosynthetically. In the motile form, coccolith ^{14}C amounted to less than 2% of photosynthetic ^{14}C. (BBB)

31804 LABELING OF ANTISERUMS WITH ^{131}I FOR USE IN IMMUNOLOGY. Ruffie, A.; Ducassou, D.; Blanquet, P. (Hopital Saint-Andre, Bordeaux). Rev. Med. Liege; 23: Suppl. No. 1, 65-6(Oct 1968). (In French).

Methods for ^{131}I labeling of antisera were compared and some possible mechanisms of reactivity were discussed. For labeling of 5 μg of an antiserum such as a globulin, 2 mCi of ^{131}I were used with the chloramine T technique. Following chromatographic separation it was found that with rabbit antiserum, the γ-globulin contained 5% of the total ^{131}I radioactivity in the serum. On this basis, the total labeling of the serum was from 55 to 60%, as compared to about 70% for antigenic glycoprotein. There was no evidence that the immunological potential of the ^{131}I-labeled antiserum was diminished by radioiodination. It did not seem possible to label the antisera with ^{131}I completely by a single procedure. The major difficulty was the separation of the excess labeled antigen used from the radioactive immunological complex. Methods for improving the reactivity of the ^{131}I labeled antiserum obtained from rabbit placentas during the last week of gestation were studied. The use of ^{131}I-labeled antiserum facilitated historadiographic evaluation of its localization. (BBB)

31805 IMPROVED METHOD FOR SIMULTANEOUS COUNTING OF ^{51}Cr AND ^{125}I IN BLOOD VOLUME MEASUREMENT. Bramson, M. Med. Res. Eng.; 8: 8-10(Oct-Nov 1969).

An automated system is described for blood-volume determinations using ^{51}Cr as an erythrocyte tracer and ^{125}I as a plasma label. The main γ radiations from these 2 isotopes are at 320 keV and about 30 KeV, respectively, which are far enough apart to measure them separately when simultaneously present. However, the separation process is not troublefree. About 12% of the ^{51}Cr counts overlap the ^{125}I spectrum, thus creating a problem in separating the 2 spectra. A window D is set to cover the energy range A−B that encloses the ^{125}I spectrum. The ^{125}I has a single peak at about 30 KeV and a coincidence summing peak at about 60 KeV, so that the KeV range used for A−B is 10 to 75. A counting rate in window D is C_{ab} and a further count rate C_{b+} is taken from the top level of window D including all pulses that exceed that level. A block diagram of the system is shown in which a well counter with its pre-amplifier is connected to a linear amplifier, the output of which is applied to a differential discriminator. The discriminator has the window setting A−B and 2 outputs C_{ab} and C_{b+} as defined above. The difference between the mean reading for an isotope, and that for the isotope in the presence of the other, did not exceed ~0.4% ± 0.6%. The various electronic operations are automatically effected as the operator goes through a simple operating procedure. (BBB)

31806 MODIFIED DEGRADATIVE PROCEDURES ON ^{14}C COMPOUNDS IN BIOSYNTHETIC STUDIES. Gordon-Gray, C. G.; Schlosser, F. D. (Univ. of Natal, Pietermaritzburg, South Africa). J. S. Afr. Chem. Inst.; 22: 165-7(Sep 1969).

In numerous biosynthetic studies in which ^{14}C-labeled precursors are used, the degradation of the product necessitates definite procedures to enable the activities of the various constituent carbon atoms to be established. Some of the more useful methods are described and illustrated by reference to recent work on the biosynthesis of Senecio alkaloids. One method involves ^{14}C-methyl determination and the assessment of the activities of the carboxy and methyl carbons of the resultant acetic acid. Kuhn−Roth oxidations are capable of yielding useful information on the general distribution of the ^{14}C activity within a compound, since it is possible to ascertain the activity not only of the ^{14}C-acetic acid generated but also of the ^{14}C-carbon dioxide liberated during the oxidation. The usual procedure was simplified by the pyrolysis of barium acetate in a C−H combustion apparatus in a stream of oxygen. The reaction proceeded as previously, except that the acetone, if formed, was totally combusted to carbon dioxide. The barium carbonate remaining was regenerated with phosphoric acid. In the conversion of iodoform to carbon dioxide it was found that wet oxidation was unsuitable when using the proportional counter, possibly due to contamination of the barium carbonate with iodine. It was found advantageous to modify this method by converting the iodoform to carbon monoxide using silver nitrate without ethyl alcohol. An example of the results is outlined. (BBB)

31807 DOES LABELING PROTEIN HORMONES WITH RADIOACTIVE IODINE CAUSE A MODIFICATION IN THE IMMUNOLOGIC BEHAVIOR OF THESE SUBSTANCES? Ooms, H. A. (Univ. Libre, Brussels). Rev. Med. Liege; 23: Suppl. No. 1, 5-6(Oct 1968). (In French).

The effect of external labeling with ^{131}I on the immunological properties of insulin were studied. A radioimmunologic dose was reached in two successive stages, and by use of a double labeling procedure with ^{131}I it was possible to compare the immunological behavior of the radioiodinated and the unlabeled insulin. Radioiodination with ^{131}I altered the immunological properties of the hormone. This consisted essentially of a nonsaturation of the reactive sites of the antibody. The magnitude of the alteration varied according to the method of oxidation used, and increased with the degree of ^{131}I iodination. Basically, the population of molecules labeled with ^{131}I exhibited heterogeneous behavior toward the antibody. As a result, radioimmunological study of the antigen-antibody reaction was considered to be open to question. However, the radioimmunological titration did not seem to be affected. The specificity of ^{131}I-labeled insulin antigenic sites for antibody, techniques of ^{131}I radioiodination, estimation of biological dosage, and purification procedures were discussed. (BBB)

Metabolism, Physiology, and Toxicology

Refer also to abstracts 31679, 31707, 31889, 31892, 31897, 31974, 31901, 32054, 32055, 32095, 32112, and 32286.

31808 (ANL-7489) RADIOLOGICAL PHYSICS DIVISION ANNUAL REPORT, JULY 1967 THROUGH JUNE 1968. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 129p. Dep. CFSTI.

Thirty papers or abstracts of papers are included. Separate abstracts were prepared for 18 papers or groups of papers. Two papers for which abstracts were not included are on wide-band spectra of atmospheric turbulence and rickets in rats. (M.C.G.)

For abstracts of individual papers see: 31301, 31484, 31676–31678, 31736, 31809–31816, 31976–31978, and 32142.

31809 (ANL–7489, pp 19–23) PRELIMINARY REPORT ON THE DISTRIBUTION OF ^{241}Am FOLLOWING ACCIDENTAL INHALATION. May, Harold A. (Argonne National Lab., Ill.).

The distribution of ^{241}Am in four persons who inhaled unknown amounts of ^{241}Am as a result of metallurgical processing was studied using a whole-body counter. Data from these persons were compared to data from studies on beagle dogs. The approximate allocations of activity were concluded to be as follows: head and arms 19.5% from bone, none from soft tissue; chest 28.0% from bone, 16% from soft tissue; pelvis 16.6% bone, none from soft tissue; legs and feet 20.0% bone, none from soft tissue. (C.O.)

31810 (ANL–7489, pp 24–30) COMPARATIVE KINETICS AND AUTORADIOGRAPHY OF ^{45}Ca AND ^{133}Ba IN 10-YEAR-OLD BEAGLE DOGS. Ellsasser, J. C.; Farnham, J. E.; Marshall, J. H. (Argonne National Lab., Ill.).

Three 10-yr-old beagle littermates were used to study the plasma specific activity and body retention of calcium–45 and barium–133. One animal was injected only with ^{45}Ca, one was injected only with ^{133}Ba, and the third received a double tracer injection of ^{133}Ba and ^{45}Ca. Distribution and retention data were similar in all animals; pre-existing bone mineral treated Ba and Ca in a nondiscriminatory manner. The data also verified the increased rate of transfer of the heavier alkaline earth without localizing the effect. It was concluded that a surface uptake of Ba was observed as well as increased rates of transfer of heavier alkaline earths from blood to bone. (C.O.)

31811 (ANL–7489, pp 30–3) THOROTRAST: AN INTRAPERITONEAL INJECTION. Lucas, Henry F. Jr.; Markun, Frank (Argonne National Lab., Ill.).

Thorotrast was injected intraperitoneally in a male rat. After 1085 days, the rat was sacrificed; urine and feces were collected throughout the entire period. The ^{228}Ra and ^{228}Th excretion rates, whole-body content, and content of ^{212}Bi, ^{212}Pb, ^{228}Ra, and ^{228}Th in blood, bone, lungs, and muscle were determined. Results are presented in tabular form. It was concluded that large doses of Thorotrast given experimental animals intraperitoneally enable one to evaluate the complicated metabolism of Thorotrast daughters accurately. (C.O.)

31812 (ANL–7489, pp 33–6) DEPOSITION OF URANIUM IN BONE. Rowland, R. E.; Farnham, J. E. (Argonne National Lab., Ill.).

The distribution of uranium in bone was studied to determine whether uranium is deposited in bone as a calcium-like ion or as a bone-surface seeker when the uranium was present as the uranyl ion in plasma. The uranium isotopes ^{232}U and ^{233}U were used with dogs at doses of 25 to 200 μCi. Dogs were sacrificed at times up to 72 days after injection. Results indicated that this ion behaves in a unique manner in bone. It is distributed in three different ways: it is a bone surface seeker, but does not remain firmly bound to surfaces indefinitely; it deposits in hotspots in newly formed bone; and it is able to penetrate the canalicular network and form a diffuse distribution in pre-existing bone. (C.O.)

31813 (ANL–7489, pp 43–53) UPTAKE OF ^{45}Ca IN THE ACELLULAR-BONED TOADFISH. Simmons, David J.; Simmons, Natalie B.; Marshall, John H. (Argonne National Lab., Ill.).

Bone growth and calcium metabolism were studied in marine acellular-boned toadfish (Opsanus tau) by tetracycline and ^{45}Ca labeling over a 21-day period. Microdensitometric analysis of contact autoradiographs of sections from the jaws indicated that peak ^{45}Ca uptake occurred on all cortical bone surfaces within 60 minutes and that there was little loss of the label thereafter. No diffuse labeling could be detected, presumably owing to the absence of osteocytes, lacunae, and canaliculi, which, in cellular bone, permit exchange of radioactive calcium atoms in the extracellular fluid with calcium atoms deep within the skeleton. Attempts to measure appositional bone growth by the separation of two tetracycline labels administered at an interval of 18 days were unsuccessful, and we could only distinguish single fluorescent bands which, subperiosteally, were 8 to 9 μ thick. These single bands were probably the result of a very low rate of excretion of tetracycline from the blood which has been observed for toadfish together with a very low rate of appositional bone growth of only 0.2 to 0.3 μ/day. (auth)

31814 (ANL–7489, pp 53–68) EFFECT OF DELADROXONE AND DELADROXATE ON THE SKELETONS OF RATS AND MICE. Simmons, David J.; Cummins, Helen (Argonne National Lab., Ill.).

The skeletal development of young growing female rats and mice injected with large doses of a long-acting pure progestogen (Deladroxone) alone or in combination with estradiol (Deladroxate) has been followed by histologic, histochemical, X ray, and autoradiographic techniques. Radiostrontium was also used to assess the effect of the hormones on mineral metabolism. Deladroxone did not affect linear growth of bone in rats and mice, but fewer trabeculae than normal formed in the metaphyses. In rats, Deladroxate treatment depressed linear bone growth, impaired endochondral bone formation and resorption, and decreased the skeletal retention of radiostrontium (^{85}Sr). In mice, Deladroxate stimulated endosteal bone formation, and in very large doses, inhibited proliferation of cells in the epiphyseal cartilages. The effects of Deladroxate appeared due to its estrogen component. (auth)

31815 (ANL–7489, pp 77–81) COMPARISON OF THE RELATIVE RATES OF TRANSFER OF BARIUM, RADIUM, AND STRONTIUM BETWEEN BLOOD AND BONE. Lloyd, Elizabeth (Argonne National Lab., Ill.).

When ^{133}Ba and ^{223}Ra are injected intravenously, they are cleared from blood to bone at a more rapid rate than ^{47}Ca in both man and the rat. In man they are cleared about 3 to 5 times as fast as Ca, while in the rat the clearance rate is 6 to 8 times as rapid as for Ca. Measurements made with a ^{85}Sr tracer indicate that in man the rate of clearance from the blood to bone is approximately the same as for Ca but the rabbit and the rat appear to clear Sr about 30% faster than Ca at short times. At long times after injection (460 days) in the rabbit, Sr was also released preferentially to Ca. When the transfer rates were calculated from the Ca tracer results and expressed as a percentage of the whole-body calcium per year, the rates were 18% in man, 40% in the rat, and 110% for the rabbit. These transfer rates for man are typical of values reported by other workers; however, the present analysis shows that not only do Ba and Ra yield much higher values for the apparent transfer rates for calcium when used as tracers for Ca, but the difference between them changes as a function of time after injection and appears to be different in different species. (auth)

31816 (ANL–7489, pp 81–7) MICROSCOPIC DISTRIBUTION OF RADIUM IN BONE BY THE METHOD OF THICK-SOURCE ALPHA-RAY SPECTROSCOPY. Bordell, Frank L. (Argonne National Lab., Ill.).

Kolenkow's technique has been utilized to determine the distribution of ^{226}Ra and daughters in beagle femur specimens. These specimens revealed a uniform distribution ($L = \infty$) of radium except for the case of ^{210}Po (RaF), which gave an effective L value of 2 μ. Following removal of 36 μ of bone surface, the RaF also behaved as if uniformly distributed. ($L = \infty$). The speculation is that RaF concentrates at the bone surface due to a fallout effect arising from radon diffusion. Recounting the specimen 95 days later verifies this hypothesis as again the ^{210}Po peak stood out above the others with a low L value of 4 μ. Though an apparent absorbing layer of 1.3 μ was observed, we feel this was due to oxidation of the bone surface and does not represent an inactive bone layer. That such can be observed was proved by the use of aluminum foils in conjunction with a thin radium source. (auth)

31817 SUBCELLULAR DISTRIBUTION OF PLUTONIUM IN RAT LIVER. Boocock, G.; Danpure, C. J.; Popplewell, D. S.; Taylor, D. M. (Atomic Weapons Research Establishment, Aldermaston, Eng. Inst. of Cancer Research, Sutton, Eng.). Radiat. Res.; 42: 381–96(May 1970).

The subcellular distribution of plutonium and ^{59}Fe in rat liver was studied over periods of up to 96 days following intravenous injection of one or both metals as their citrate complexes. At one hour after injection 40% of the total liver ^{59}Fe and 64% of the plutonium were present in the soluble fraction (105,000g supernatant), but by 10 days the proportions in this fraction decreased to 12 and 5%, respectively. The fall in the amounts of ^{59}Fe and plutonium in the soluble fraction was matched by an increasing association with the formed elements of the cells. Differential centrifugation and centrifugation through a sucrose density gradient showed that the plutonium was predominantly associated with the lysosomes. Further fractionation of the soluble fraction by gel-permeation chromatography on Sephadex showed that essentially all the plutonium and ^{59}Fe is bound to protein within one hour of injection. By about three days the major portions of both ^{59}Fe and plutonium were associated with ferritin. (auth)

31818 ABSORPTION OF URANIUM AND ITS DECAY PRODUCTS BY MYCOCOCCI. Krasil'nikov, N. A.; Kharat'yan, I. G.; Koval'skii, Yu. V. (Inst. of Microbiology, Moscow. Moscow

State Univ.). Dokl. Vses. Akad. Sel'skokhoz. Nauk, No. 6, 2-4 (1969). (In Russian).

Soil microorganisms, including the genus Mycococcus, that are members of cenoses of primitive soils and lichens, are capable of taking up uranium and thereby participating in the process of rock disintegration. The uptake of uranium as an alpha emitter and of its decay products as beta emitters was studied. The uranium source was uranyl nitrate that was added to a meat-peptone-agar medium after sterilization. The distribution of uranium and its decay products between the microorganisms (42 mycococcal strains) and the medium was found to be selective in nature. The ratio of the elements (i.e., α/β) in the biomass of microbes reflected a shift in the radioactive balance toward an excess of beta emitters. (JPRS)

31819 DISTRIBUTION AND EXCRETION OF INHALED Eu BY RATS AS APPLIED FOR AND ACTIVABLE TRACER. Suzuki, M.; Ohno, S.; Okabayashi, H.; Hongo, S.; Oohata, T. (National Inst. of Radiological Sciences, Chiba, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 442-4(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Results are reported from a study on the tissue distribution and excretion patterns of europium nitrates in rats following inhalation in submicron aerosols, in which ^{152}Eu was used as a tracer. Results showed that, although Eu nitrate is a very soluble chemical compound, very little is absorbed from the lungs and GI tract following inhalation as aerosol. About 5 to 40% of the amount deposited in the respiratory system was excreted in feces in about two days, while about 1% was translocated to liver and bone during a 30-day period. (C.H.)

31820 USE OF ^{15}N AS A TRACER IN FERTILIZER EFFICIENCY STUDY IN JAPAN. Nishigaki, Susumu (National Inst. of Agricultural Science, Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 669-76(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The use of ^{15}N as a tracer for studies of fertilizer efficiency and plant nutrition in Japan is reviewed. The advantages of using ^{15}N as a tracer to obtain information on the contribution of nitrogen fertilizer to crop production when applied at various growth stages are discussed. (C.H.)

31821 APPROPRIATE FIELDS OF RADIOISOTOPES TO THE RESEARCH IN ANIMAL PRODUCTION. Nozaki, Hiroshi. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 677-81(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Applications of radioisotopes in animal husbandry in Japan include the use of ^{14}C and ^{32}P as tracers for studies on nutrient metabolism and growth patterns of forage grasses; the use of ^{14}C and tritium as tracers for studies of fatty acid metabolism in dairy cattle; the use of ^{131}I as a label for the radioimmunoassay of prolactin and growth hormone in blood serum of dairy cattle; the use of ^{131}I uptake as an indication of thyroid function in dairy cattle; and the development of methods for the removal of fallout ^{137}Cs, ^{131}I, ^{89}Sr, and ^{90}Sr from milk. Poultry studies include the use of ^{14}C-labeled amino acids for metabolic studies in chicks and the use of ^{131}I-labeled thyroxine for in vitro tests of thyroxine activity in blood serum of chickens as an indication of thyroid function. (C.H.)

31822 RADIOISOTOPE USES IN DRUG MAKERS: CURRENT TOPICS ON DRUG METABOLISM. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 837-58(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Problems involved in the use of ^{3}H- or ^{35}S-labeled drugs for studies of drug metabolism in experimental animals are discussed. These include the biochemical stability of the labeled compound, the preparation of the labeled compound, measurements of activity in various tissues, and determination of the pharmacological significance of the distribution data. (C.H.)

31823 USE OF RADIOISOTOPES IN HERBICIDE RESEARCH. Crafts, A. S. (Univ. of California, Berkeley). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 1010-17(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Reaction mechanisms involved in the uptake and distribution of herbicides in plants were studied using ^{14}C-labeled herbicides and autoradiography. Data on the uptake of some 35 herbicides following various means of application are included. (C.H.)

31824 INFLUENCE OF SALINITY AND TEMPERATURE ON THE ACCUMULATION OF ^{137}Cs BY AN ESTUARINE CLAM UNDER LABORATORY CONDITIONS. Wolfe, Douglas A.; Coburn, C. B. Jr. (Bureau of Commercial Fisheries, Beaufort, N. C.). Health Phys.; 18: 499-505(May 1970).

Accumulation of cesium-137 by the clam Rangia cuneata was described by asymptotic exponential regressions at 20 salinity-temperature combinations (1-20‰, 5-25°C). Regression constants from the individual experiments were subjected to regression analysis and were expressed as functions of salinity and temperature. Concentration factors decreased with increasing salinity, but increased with temperature. The proportion of cesium-137 associated with the shell decreased as salinity or temperature was increased. (auth) (UK)

31825 SUSCEPTIBILITY OF ISOTOPICALLY LABELED MAMMALIAN NUCLEI TO DEOXYRIBONUCLEASE I. Robins, A. B. (Inst. of Cancer Research, Surrey, Eng.). Radiat. Res.; 42: 552-9(Jun 1970).

Nuclei from murine lymphoma cells (L5178Y), labeled with 1.5 μCi ^{14}C per mg DNA were digested with deoxyribonuclease I. The DNA which remained acid precipitable after various time intervals was found to have a lower specific radioactivity than the original material. The same behavior was observed when isolated radioactive DNA was enzymically digested, suggesting that the labeled DNA itself is more labile to nuclease action. It is considered unlikely that the effect is due to damage caused to the DNA by either the emergent β-particle or by recoil. Possibly the labeled DNA behaves as a modified substrate for the enzyme. (auth)

31826 ANOMALY IN POTASSIUM ACCUMULATION BY BARLEY ROOTS. II. EFFECT OF CALCIUM CONCENTRATION AND ^{86}Rb LABELING. Hiatt, A. J. (Univ. of Kentucky, Lexington). Plant Physiol.; 45: 411-14(Apr 1970).

When excised barley roots were incubated in 0.01 to 0.1 mM KCl solutions containing 0.2 mM $CaSO_4$, there was a peak in the K^+ accumulation against concentration curve at 0.02 to 0.04 mM KCl. The peak in the K^+ accumulation curve was shifted to lower K^+ concentrations when Ca^{2+} concentration was decreased and to higher K^+ concentrations when Ca^{2+} concentration was increased. Increasing Ca^{2+} concentration in the treatment solution was observed to be stimulatory, inhibitory, or neutral depending on the K^+ concentration. When ^{86}Rb was used as an isotopic tracer for K^+, accumulation of K^+ was grossly overestimated, and the apparent K^+ accumulation curve, as estimated with ^{86}Rb-labeled K^+, was hyperbolic over the concentration range of 0.01 to 0.1 mM. It was concluded that ^{86}Rb is a poor tracer for K^+ over the concentration range of 0.01 to 0.1 mM. Accumulation of Rb^+ in the presence of K^+ was accurately measured by ^{86}Rb. (auth)

31827 RADIOISOTOPES IN THE INVESTIGATION OF INTERRELATIONSHIPS BETWEEN APHIDS AND HOST-PLANTS. Kloft, W.; Ehrhardt, P.; Kunkel, H. (Univ., Bonn). pp 23-30 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Activities of the aphid on the host-plant, such as probing, starting of feeding and salivation, can be observed by labeling either host-plant or insect with a radioactive isotope. The course of plant sap uptake, assimilation into the organism, haemolymph circulation, and incorporation into different tissues, especially salivary glands and embryos, were investigated with this method. Artificial feeding of aphids through membranes enabled isotope studies to be performed independently of the host-plant. Studies of excretion via honeydew, saliva and newborn larvae were also carried out. Detailed results are presented on the processes of saliva injection and transport in the plant tissue, which are important from the point of view of phytopathology and virus transmission. (auth)

31828 RADIOISOTOPES IN STUDIES ON THE ECOLOGY OF TICK VECTORS OF DISEASE. Sonenshine, D. E. (Old Dominion Coll., Norfolk, Va.). Contract AT(40-1)-3514. pp 31-52 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

The feasibility of mass rearing of radioisotope-tagged immature ticks by collecting the progeny of engorged females of three species inoculated with carbon-14 glucose or glycine prior to oviposition is demonstrated. The incorporation of radiochemicals internally into ticks reduces the chance of loss of the radioactive label when moulting occurs, or under natural conditions. Most treated ticks laid eggs. The amount of radioactivity in the progeny could be controlled by controlling the size of the dose administered to the parent ticks. However, differences in radioactivity in

the progeny of treated ticks in relation to the day of oviposition were noted. This activity declined progressively through the ninth day. Differences were also noted in relation to the radiochemical used. Most of the carbon-14 glycine (79.0%) received by the engorged females remained in the parents, whereas most of the carbon-14 glucose (77.5%) received was transferred to the progeny. Hatching of eggs labeled by this method was less than in untreated oviposits. Radiosensitivity in the eggs was also noted and was related to the size of the dose administered to the parent tick. No hatching occurred when the average radioactivity of the labeled eggs exceeded 637 counts/min per egg over background. Nevertheless, many highly radioactive eggs hatched, and larvae with counts as high as 510 counts/min per larva over background were observed. The biological characteristics of the tagged larvae were apparently unaffected by incorporation of radiochemicals into these individuals. The proportion of marked larvae which attached to hosts was similar to the proportion of unmarked larvae which attached. The duration of survival of fasting, radioisotope-tagged larvae, under laboratory conditions, was similar to the period of survival of nonradioactive larvae. No apparent loss in radioactivity in fasting larvae held for up to 70 days under laboratory conditions was detected. This demonstration of the feasibility of mass rearing and long-term survival of radioisotope-tagged immature ticks suggests that it is now possible to apply this radioecological technique to obtain important new knowledge on the ecology of tick vectors of disease. (auth)

31829 PLASMA CONCENTRATIONS OF RADIOCALCIUM AFTER ORAL ADMINISTRATION, AND THEIR RELATIONSHIP TO ABSORPTION. Tothill, P.; Dellipiani, A. W.; Calvert, J. (Univ. of Edinburgh). Clin. Sci.; 38: 27-39(1970).

Different radioisotopes of calcium were administered orally and intravenously to a series of patients, some normal and others with diseases that might affect calcium absorption or metabolism. Concentrations of the two isotopes in plasma were determined at intervals. A mathematical procedure was developed for deriving from these measurements the total absorption of the oral dose and also the absorption/time relationship. The correlation between absorption and plasma concentration of the oral dose at various times after administration was studied and found to be very good, the 2 hr plasma level giving the best correlation, particularly when account was taken of the patient's weight. The effect of variations in the disappearance curve of the injected isotope upon the shape of the plasma appearance curve of the oral isotope was examined. It is concluded that for the majority of cases, when absorption is not greatly delayed, and the exchange processes determining the shape of the disappearance curve are not markedly abnormal, 2 hr plasma concentration gives a good indication of absorption. When abnormalities in these processes are present, only the double isotope method gives accurate results. The results were applied to examine the validity of other published methods of analysis. It was found that plasma concentrations of orally administered radiocalcium alone can give useful information about absorption, but not about plasma clearance. (auth) (UK)

31830 EFFECT OF EPINEPHRINE UPON ^{45}Ca UPTAKE BY ISOLATED ISLETS OF LANGERHANS. Malaisse-Lagae, Francine; Mahy, Marianne; Malaisse, Willy J. (Univ., Brussels). Horm. Metab. Res.; 1: 319-20(1969).

In summary it was found that epinephrine inhibited the uptake of ^{45}Ca by isolated islets of Langerhans incubated in the presence of glucose. (auth)

31831 THE EFFECT OF THE PRUSSIAN BLUE COMBINED WITH PILOCARPINE IN THE ELIMINATION OF ^{137}Cs IN RATS. Havlicek, F.; Beran, M. (Military Research Inst. of Veterinary Medicine, Prague). Vet. Med. (Prague); 14: 465-70(Aug 1969). (In Czech).

Prussian blue as a 1% addition to the rat diet decreased the retention of intraperitoneally administered ^{137}Cs in the organism, and resulted in a decreased deposition, mainly in liver, kidneys, duodenum, and bones. A repeated 10 days' administration of pilocarpine in doses of 4, 16, 40, and 160 mg per rat daily neither caused any further increase in the elimination of ^{137}Cs nor promoted its redistribution within the organism.

31832 EFFECT OF TESTOSTERONE PROPIONATE ON THYROID AND PLASMA UPTAKE OF ^{131}I IN CASTRATED MALE RATS TREATED OR NOT WITH THIOURACIL. Kowalewski, K. (Univ. of Alberta, Edmonton). Arch. Int. Pharmacodyn., 175: 123-8(Sept. 1968).

The effect of testosterone propionate on thyroid and plasma uptake of ^{131}I in castrated male rats treated or not with thiouracil, a compound inhibiting organification of radioiodine by the thyroid gland, was studied. No significant difference was found between rats treated with testosterone propionate and untreated controls with respect to uptake of ^{131}I by plasma and thyroid glands. A significant difference was found between animals fed normal diet and those fed the thiouracil diet. In thiouracil-treated rats, ^{131}I uptake by plasma was higher and ^{131}I uptake by thyroid glands was lower than in rats fed normal diet. The effect of thiouracil on the morphology of the thyroid gland was reflected by the increase in the weight of the thyroids. Decreased thyroidal uptake of radioiodine was evidently due to a known action of thiouracil on the conversion of inorganic to organic ^{131}I. Increased uptake of ^{131}I by plasma may be the result of decreased utilization of circulating ^{131}I by the thyroid. (BBB)

31833 EFFECT OF LACTATION ON METABOLISM OF CALCIUM. Blanusa, Maja; Durakovic, A.; Kostial, Krista (Inst. for Medical Research, Zagreb). Arh. Hig. Rada Toksikol.; 19: 37-40(1968). (In French).

Previous results have shown diminished radiocalcium retention in lactating animals. The present studies were performed in 4-month-old rats with ^{47}Ca. The maternal rats had been maintained on a standard diet with their offspring for 12 days after birth and were then injected intraperitoneally with ^{47}Ca, then sacrificed, at intervals, up to 45 hr. A scintillation counter was used to measure ^{47}Ca in the tibia, as well as serum levels. The drop in radiocalcium in serum was more marked in lactating than control rats. The uptake of ^{47}Ca in both the diaphyses and ends of the tibia was much less marked in the lactating rats. (BBB)

31834 ^{51}Cr TRANSPORT IN THE XYLEM SAP OF LEPTOSPERMUM SCOPARIUM (MANUKA). Lyon, G. L.; Peterson, P. J.; Brooks, R. R. (Massey Univ., Palmerston North, N. Z.). N. Z. J. Sci.; 12: 541-5(Sep 1969).

When ^{51}Cr (as Na_2CrO_4) was fed to the roots of Leptospermum scoparium, only the chromate ion was found in the xylem sap from roots and shoots of seedlings grown on serpentine and on silt loam. This contrasts with soluble extracts of leaves, stems and roots, which contain three anionic ^{51}Cr-complexes. The results show that hexavalent ^{51}Cr-chromate is absorbed from solution and transported in the xylem throughout the plant. Metabolism of chromate would therefore take place in leaf tissue to give trioxalatochromate(III) ion. Whether or not metabolism of $^{51}CrO_4$ to the chromium complexes takes place only in the leaves and is then translocated in the phloem to the rest of the plant, or, whether all tissues can synthesize the complexes remains to be ascertained. The transport of ^{51}Cr as chromate in the xylem sap of L. scoparium is therefore analogous to that of S and P which are principally transported as inorganic anions in xylem sap. (BBB)

31835 NEW VIEWS OF CALCIUM AND STRONTIUM METABOLISM. ROUND TABLE. Milhaud, G. (Faculte de Medecine, Paris); Collignon, G.; Michel, R.; Miravet, L.; Perault-Staub, A. M.; Richelle, L.; Robillard, J.; Schoffeniels, E. Rev. Med. Liege; 23: Suppl. No. 1, 219-26(Oct 1968). (In French).

Current theories of the metabolic behavior of ^{45}Ca and ^{89}Sr were discussed. Various effects of enzymes, thyroid hormones, and several energy-producing mechanisms were presented. The mechanisms of active transport, energy relations, and thermodynamic factors were considered. Possible mechanisms that involved the action of thyrocalcitonin, triiodothyronine (T3), adenosine phosphates, and other metabolites were presented. A schematic model that represented the metabolism of Ca was presented and discussed. The mitochondrial uptake of Sr, and effect of T3 and triiodothyroacetic acid on the possible uptake mechanism were outlined. The roles of molecular transfer and membrane permeability were discussed briefly. (BBB)

31836 COMPARATIVE KINETICS AND AUTORADIOGRAPHY OF ^{45}Ca AND ^{133}Ba IN TEN-YEAR-OLD BEAGLE DOGS: THE DIFFUSE COMPONENT DISTRIBUTION THROUGHOUT THE SKELETON. Ellsasser, James C.; Farnham, Joseph E.; Marshall, John H. (Argonne National Lab., Ill.). J. Bone Joint Surg.; 51A: 1397-1412(Oct 1969).

The techniques of radioisotope kinetics and quantitative autoradiography were used to investigate the differences between the uptake of ^{45}Ca and ^{133}Ba in the skeletons of adult dogs. The kinetic measurements verified the expected preferential uptake of ^{133}Ba. On the other hand, the autoradiographic measurements led to a new hypothesis about the mechanism of this preference. In the course of these measurements a complete bone-by-bone survey of the ^{45}Ca diffuse component was made. The 10-yr-old beagle dogs were killed 7 days after injection of the isotopes. The rate of long-term transfer from blood to the skeleton measured at 5 days (A_5) was 2 to 3 times larger for Ba than for Ca. This preference for Ba could not be explained by differences in diffuse uptake, but rather by an increased uptake of Ba on inactive bone surfaces. Furthermore, the shape of the curve of ^{133}Ba specific activity in the plasma at very short times after injection was consistent with a passive diffusion from blood to the plane sur-

faces of bone and tissue, whereas the shape of the ^{45}Ca plasma curve suggested that some kind of active transport may be counteracting the diffusion of Ca from blood to bone. Such active transport might be associated with the endosteal cells lining bone surfaces. The diffuse specific activity of ^{45}Ca throughout the skeleton showed variations of as much as a factor of 2.5 from one site to another. (BBB)

31837 A COMPARISON BETWEEN THE UPTAKES OF RADIOACTIVE PERCHLORATE AND IODIDE BY RAT AND GUINEA-PIG THYROID GLANDS. Chow, S. Y.; Chang, L. R.; Yen, M. S. (National Defense Medical Center, Taipei, Taiwan). J. Endocrinol.; 45: 1-8(Sep 1969).

The influence of carrier and/or simultaneous administration of various amounts of stable perchlorate or iodide on the uptakes of ^{36}Cl-perchlorate and radioiodine (^{131}I) by the rat and guinea-pig thyroid glands was studied. To assess the effect of the functional state of the thyroid on the uptakes of these radioisotopes, some experiments were also repeated on hypophysectomized animals, as well as on others pretreated with thyrotropin (TSH) or with propylthiouracil (PTU) for a protracted period. The radioisotope solutions containing different amounts of stable perchlorate or iodide (doses ranged from 0.005 to 5 meq/kg body weight) were injected into rats and guinea pigs, and the thyroid:plasma concentration ratios of radioactive perchlorate and radioiodide were calculated and compared. At the same dose levels of perchlorate there was no difference in thyroid:plasma concentration ratios of radioactive perchlorate and radioiodide in control rats and guinea pigs or in treated ones. (BBB)

Radiation Effects

Refer also to abstracts 31432, 31903, 31926, 32035, 32037, 32143, 32145, 32158, 32160, 32195, 32210, 32213, 32222, and 32280.

31838 (CONF-691120-1) EFFECT OF FAST NEUTRONS AND GAMMA RAYS ON SOYBEAN SEEDLING GROWTH AND MALATE DEHYDROGENASE ISOZYME PATTERN FOLLOWING SEED IRRADIATION. Koo, F. K. S.; Ferrer-Monge, J. A.; Otero, Angelica M.; Bulla, Isabel; Alemany, Adela (Puerto Rico Nuclear Center, Rio Piedras, Puerto Rico Nuclear Center, Mayaguez). [1969]. Contract AT(40-1)-1833. 12p. Dep. CFSTI.

From Meeting on the Use of Seeds as Biological Monitors for Neutron Irradiation, Knoxville, Tenn.

Seedling growth retardation and changes in isozyme pattern of malate dehydrogenase (MDH) were employed as indices in the studies of fast neutron and gamma irradiation effect on soybean seeds. Six doses (1 to 5 krads) of fast neutrons and 5 doses (10 to 50 krads) of gamma rays were used for seedling growth retardation study. For each treatment, 30 seeds per replication with 3 replications were planted in the growth chamber where a constant temperature (24°C) and illumination (16 h daily) were kept. Measurements on growth of seedling parts below and above the cotyledons were made at intervals. Growth inhibition was found to increase with increasing dose. This effect was very pronounced on the shoot growth, particularly with the gamma-irradiated material at higher doses. Fast neutrons appear to be more efficient than gamma rays in inducing seedling growth retardation. Disc-electrophoresis was used to study the changes in isozyme pattern of MDH extracted from soybean seedlings grown from seeds exposed to 1.5 krads of fast neutrons or 15 krads of gamma rays. Five- and twelve-day old seedlings grown under light and in the dark were divided into 5 parts—roots, hypocotyl, cotyledons, epicotyl and leaves for the analysis. With only a few exceptions, differences in isozyme pattern were observed between the control and the irradiated and also between the materials treated with two radiations. These changes include increase, only rarely decrease, in number of major and minor bands, width of the bands and staining intensity. Tissue and developmental stage specificity for isozyme pattern was also evident when the controls or the irradiated materials were compared. Light- and dark-growing conditions also caused a change in the isozyme pattern. (auth)

31839 (ORNL-4558) SUMMARIES FROM ORNL-4559. THE MOLECULAR ANATOMY PROGRAM (THE MAN PROGRAM). Second Semiannual Progress Report, September 1, 1969–February 28, 1970. (Oak Ridge National Lab., Tenn.). Apr 1970. Contract W-7405-eng-26. 128p. Dep. CFSTI.

Separate abstracts were prepared for four sections of the report. An additional 34 sections are included on gel electrophoresis, molecular anatomy of the nucleus, sedimentation counting of virus, design for zonal centrifuges, and other aspects of the molecular anatomy program. (H.L.W.)

For abstracts of individual sections see: 31840, 31841, 31864, and 32059.

31840 (ORNL-4558, pp 29-32) MOLECULAR SIZE OF MAMMALIAN DNA. Klucis, E.; Lett, John (Oak Ridge National Lab., Tenn.).

For studies on measurement of DNA in mammalian chromosomes and DNA repair capacity of mammalian cells following irradiation, a B-XV titanium rotor was obtained. Experiments were conducted on use of the rotor as a reorientating system and location of a rotor speed where the rotor could be loaded while spinning at a sufficiently low speed that would not sediment the cells or their lysed products. The irradiated cells gave broad sedimentation profiles in the dose range 0.38 to 6.2 kr. The rotor was then accelerated using a slow acceleration-reorientation drive system. This instrument is being used to increase the molecular size by decreasing the radiation dose, to study abnormal sedimentation behavior of single-stranded DNA, and to attempt to ascertain the molecular weight of mammalian DNA. (H.L.W.)

31841 (ORNL-4558, pp 33-4) STUDIES ON THE FUNCTIONAL ACTIVITY OF HUMAN SERUM ALPHA-2 MACROGLOBULIN. Davis, M. L.; McDonald, T. P.; Anderson, N. G. (Oak Ridge National Lab., Tenn.).

Experiments were conducted to show that the α-2-globulin fraction of serum contains the substrate for enzymatic activation of erythropoietin. It was thought that radiation damage in mammals could cause inhibition of erythropoietin substrate synthesis without severely affecting renal erythropoietic factor (enzyme) production. Thus, injection of α-2-globulin into irradiated mice may provide the necessary substrate for erythropoietin production. Studies to confirm this hypothesis are in progress. (H.L.W.)

31842 (ORNL-tr-2327) EXTRACORPOREAL IRRADIATION OF BLOOD. Suscillon, M. Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.), from Bull. Inform. Sci. Tech. (Paris); No. 145, 43-8(1970). 6p. Dep. CFSTI.

A technique for extracorporeal γ irradiation of the blood of a large animal, a calf, is described. Some problems concerning the surgical insertion of an arterial-venous shunt and of the irradiation itself are discussed. Results are presented of peripheral blood cytology, serum proteins, blood platelet function, and hemolysis before and after irradiation. The possibility of using this method in the laboratory or in the field with animals and of human therapy applications is analyzed. (auth)

31843 (UCB-34-P-95-17) RADIATION OF HEME PROTEINS. Final Progress Report. Brown, W. D. (California Univ., Berkeley. Inst. of Marine Resources). Mar 1970. Contract AT(11-1)-34. 18p. Dep. CFSTI.

Effects of γ radiation at levels up to 500 krads on model systems containing hemoglobin or myoglobin were studied. The overall aim was to determine how such irradiation would influence the properties of these hemoproteins as pigments of meats and fish, as well as to determine the effect on the physiological properties of these respiratory proteins. The work also served to provide general information about the effects of γ irradiation on proteins in aqueous solutions using hemoproteins as models. Spectral evidence was obtained for formation of a compound resembling oxymyoglobin following irradiation of metmyoglobin and formation of metmyoglobin following irradiation of oxymyoglobin. There were also changes in uv absorption spectra. There was some precipitation of proteins following irradiation. These precipitates were not soluble in urea; however, myoglobins denatured by heat or alkali were soluble in urea. Chromatography of irradiated myoglobins showed that there was no appreciable dissociation of heme from globin. Fractionated and nonfractionated myoglobins were subjected to disc electrophoresis on polyacrylamide gels. Unfractionated myoglobins, irradiated at 500 krads, showed three bands, with the same relative mobility, although slower, as those from nonirradiated material. For determining radiation effects on heme reactivity, studies were conducted on the formation of nitrosyl myoglobin from irradiated and nonirradiated myoglobin, and the formation of ferri- and ferrohemochromes with imidazole and nicotinamide. Studies on effects of radiation on amino acid residues showed that the overall amino acid composition of myoglobins was not greatly altered. It was found, however, that scission of peptides from irradiated myoglobins occurred. Ultracentrifuge studies showed little change in sedimentation patterns of irradiated and nonirradiated samples. Studies were also conducted on production of malonaldehyde by irradiation and reactivity of malonaldehyde with irradiated proteins contamination of lipid solvents with malonaldehyde; alteration in susceptibility to denaturation; effects of pH on autooxidation of oxymyoglobins and oxyhemoglobins, non-enzymatic reduction of metmyoglobins; photo-induced oxidation and reduction of myoglobin by flavins; and effects of glutathione, EDTA, and FMN. (H.L.W.)

31844 (UCB-34-P-116-X-8) OUR INVESTIGATION AND ITS SIGNIFICANCE IN BIOLOGY AND MEDICINE. A Brief History of the Photochemistry of Proteins and of Tobacco Mosaic Virus and of Our Progress Since June 1, 1964 in Historical Context. (California Univ., Berkeley). [1970]. 37p. Dep. CFSTI.

A comprehensive review of the literature on photochemistry of proteins and tobacco mosaic virus is presented. Studies on photochemistry of enzymes and ribonucleic acids are emphasized in the review. A list of 84 references is included. A summary of papers published on recent research includes the following studies: conditions influencing the sensitivity (quantum yield) of RNA to radiation; photoreactivation action spectrum for radioinactivated RNA; evaluation of the role of pyrimidine dimers and hydrates in photoreactivation; protective effects of the protein coat of TMV on the sensitivity of RNA to radiation of 2537Å; and isolation of a plant enzyme system that will exhibit photoreactivation of radioinactivated RNA. Present investigations include studies on photoreactivation of ultraviolet-inactivated RNA from tobacco mosaic virus on white leaves of a variegated mutant of Xanthi tobacco and ultraviolet irradiation of dry RNA from tobacco mosaic virus. A photorecovery of 30 to 35% was observed and it was concluded that photosynthesis was not required for photorecovery of uv-inactivated TMV-RNA. (H.L.W.)

31845 EFFECT OF BETA IRRADIATION ON OXYGEN CONSUMPTION IN THE FROG SCIATIC NERVE. Kaack, B. (Allegheny General Hospital, Pittsburgh). Radiat. Res.; 42: 405-12(May 1970).

Frog sciatic nerves show an increase in oxygen consumption due to beta irradiation. There are two peaks in this increase. The first peak corresponds to the beginning of enhancement of the relative amplitude of the action potential where this enhancement occurs. The second peak corresponds to the drastic change occurring in the negative afterpotential that precedes the end of the nerve's ability to generate an action potential. There is a definite relation between radiation damage on the one hand, and potassium efflux, the negative afterpotential, and oxygen consumption. (auth)

31846 THE IN VITRO BIOSYNTHESIS OF CHOLESTEROL AND THE CHOLESTEROL CONTENT IN THE LIVER OF X-IRRADIATED MICE. Berndt, J.; Gaumert, R. (Univ., Freiburg i. B.). Radiat. Res.; 42: 292-304(May 1970).

The incorporation of ^{14}C-acetate and ^{14}C-mevalonic acid (MVA) into cholesterol was determined in liver slices from x-irradiated fasted mice. Those two compounds represent cholesterol precursors located before and after the rate-limiting step of cholesterol synthesis, β-hydroxy-β-methylglutaryl-coenzyme A (HMG-CoA) reductase. The results indicated that the biosynthesis of cholesterol was increased from both precursors after irradiation. A latent period was observed before the increased cholesterol synthesis was manifested, and 72 hours after irradiation the highest incorporation was obtained. The extent of stimulation depends upon the radiation dose, but this is relevant only 48 and 72 hours postirradiation. (auth)

31847 ULTRASTRUCTURAL AND ENZYME CYTOCHEMICAL CHANGES IN THE RAT THYMUS FOLLOWING X-RAY IRRADIATION. Toro, Imre; Bacsy, Erno; Okros, Istvan; Vadasz, Gyorgy; Rappay, Gyorgy (Research Inst. of Experimental Medicine, Budapest). Orvostudomany, 20: No. 1, 11-23(1969). (In Hungarian).

Light and electron microscopic cytochemical as well as starch-gel electrophoretic esterase-isozyme studies were carried out on the thymus of rats irradiated with sublethal doses of x ray. It was determined that acid phosphatase and non-specific esterase activity is exhibited to varying proportion by the reticulum cells. Results obtained with the cytochemical methods indicate that the ratio of the activity of these two enzymes remained virtually unchanged in the reticulum cells after x ray irradiation but their intensity increased. By means of starch-gel electrophoretic studies it was demonstrated that the isozyme spectrum of the thymus underwent both a qualitative and quantitative change following x irradiation. Electron microscopic studies indicated that both the dense bodies found in the mesenchymal reticulum cells and the epithelial reticulum cell-vacuoli with a content resembling pearl strains, had acid phosphatase activity, i.e., can be considered as lysozomes. Following x irradiation, a considerable increase in the lipid content of the mesenchymal reticulum cells was observed. (JPRS)

31848 EFFECT OF X-IRRADIATION ON RESPIRATION AND PROTEIN SYNTHESIS IN NEURONAL AND NEUROGLIA CELL FRACTIONS. Hamberger, Anders; Blomstrand, Christian; Rosengren, Bengt (Univ. of Goteborg). Exp. Neurol.; 26: 509-17(Mar 1970).

After a single localized exposure to x-irradiation (300 R) neurons and neuroglia cells isolated free-hand showed a striking increase in succinate supported respiration. The nerve cells were characterized by an immediate response of increased respiration during the first day, a return toward control level and a later peak on the tenth day after irradiation. The neuroglia cells showed one single peak of increased respiration after approximately 1 week. Incorporation of ^{3}H-leucine into proteins during incubation of brain slices was studied in neuron- and neuroglia cell-enriched fractions prepared by ficoll gradient centrifugation. In this system an early stimulation of incorporation was observed for the neurons. Leucine incorporation was decreased in all fractions 2 days after irradiation. During the second week the incorporation into the neuronal fraction increased above control level, while the incorporation into the neuroglial fraction remained low. Subcellular fractionation was performed on slices of brain stem previously incubated with ^{3}H-leucine. Only the mitochondria showed an increased rate of incorporation after 1 week, while all the other fractions showed decreased incorporation. The different responses among various cell types were compared with previously reported histological changes. (auth)

31849 BIOSYNTHESIS OF TESTOSTERONE IN THE TESTICULAR INTERSTITIAL CELLS OF A RAT. Futaesaku, Yutaka; Mizuhira, Vinci; Uchida, Kazuko; Okazaki, Kuninobu; Tsuzi, Kumiko (Tokyo Medical and Dental Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 433-5(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The effects of x radiation on the synthesis of testosterone in rat testis were studied using injected ^{3}H-labeled pregnenolone as a tracer and electron microscopic autoradiography or liquid scintillation spectrometry of testes fractions. Results showed that the metabolic pathway of androgens exists mainly on endoplasmic reticulum of interstitial cells of the testis. (C.H.)

31850 THE CHANGES OF LOCALIZATION OF ACETYLCHOLINESTERASE (ACHE) AND BUTYRYLCHOLINESTERASE (BCHE) ACTIVITY IN MATURING RAT CEREBELLUM AFTER γ-IRRADIATION (^{60}Co). Ostenda, M.; Renkawek, K. (Experimental and Clinical Medical Research Centre, Warsaw). Folia Histochem. Cytochem. (Krakow); 7: 63-76(1969).

The localization of acetylcholinesterase (ACHE) and butyrylcholinesterase (BCHE) activity in the rat cerebellum was investigated in the course of normal maturation and after whole-body γ irradiation with 300R on the 4th day of life. In irradiated animals a decrease in the activity of both enzymes was observed between the 10th and 25th days of life. The decrease mainly concerned ACHE and was localized in the white matter. The observed changes might be the effect of deterioration of some radiosensitive processes in the central nervous system (transmission myelination). All changes disappeared after the 25th day of life. (NSA of Poland)

31851 THERMAL AGGREGATION OF TROPOCOLLAGEN SOLUTIONS IRRADIATED WITH LOW DOSES OF IONIZING RADIATION. Jellenska, M.; Dancewicz, A. M. (Inst. of Nuclear Research, Warsaw). Int. J. Radiat. Biol.; 16: 193-6(1969).

Solutions containing 1.5 mg of collagen/ml of saline were deaerated and then x-irradiated at 410 rads/min. Ability of tropocollagen to aggregate after irradiation decreased with increasing radiation dose and the effect could be determined after exposure to 100 rads. Aggregates of native tropocollagen formed during incubation for 2 hours at 37°C redissolved on cooling to 4°C. With increasing radiation dose there was a decrease in the fraction of aggregates redissolving. At 30 krads, more than 90% remained undissolved despite prolonged cooling. Loss of the initial thermal aggregation was assumed to be due to degradative changes such as peptide-bond scission. The ability to redissolve appeared to be correlated with an increased number of aldehyde groups in collagen after irradiation. (auth) (UK)

31852 ELECTRON MICROSCOPY OF LIVER MITOCHONDRIA ISOLATED FROM X-IRRADIATED RATS. Lejsek, Karel; Tichy, Jiri; Hais, Ivo M. Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove; 10: 575-9(1967).

Fifteen and 60 minutes after a whole-body irradiation with a dose of 1400 R the most striking effect in isolated liver mitochondria (mi) is the increase in vacuolization. Twenty-four hours after irradiation the vacuoles are smaller and possibly less frequent than in the controls. Further changes in morphology of isolated rat liver mi are described as observed in these time intervals after irradiation. (auth)

31853 BLOOD CHANGES IN CALCIUM AND MAGNESIUM ION CONCENTRATIONS AFTER WHOLE-BODY X-IRRADIATION. Ababei, L.; Haler, C.; Trandafirescu, M.; Cernatescu, D.; Ionescu, M. (Inst. for Medical Research, Iasi. Inst. of Medicine, Iasi). Radiat. Res.; 42: 560-4(Jun 1970).

Following whole-body x-irradiation (600 R) of rabbits, there was an accumulation of calcium and magnesium ions in the whole blood and in the red blood cells. Pyruvate kinase activity and pyruvate concentration were decreased in the erythrocytes from the irradiated animals while the level of phosphoenolpyruvate was increased following x-irradiation. Erythrocytic pyruvate kinase was also found to be inhibited by high calcium ion concentrations. The results showed an accumulation of calcium and magnesium ions in the red blood cells after irradiation which may result in the decrease in pyruvate kinase activity and, hence, in the erythrocyte glycolytic capacity, previously observed following x-irradiation. (auth)

31854 EFFECTS OF X-IRRADIATION ON RNA AND PROTEIN SYNTHESIS IN HeLa CELLS. Kim, S. H.; Kim, J. H.; Djordjevic, B. (Sloan-Kettering Inst. for Cancer Research, New York). Radiat. Res.; 42: 577-89(Jun 1970).

Alterations in protein and RNA metabolism in asynchronously growing HeLa cell population following 2000 Rads of x-irradiation were studied using sucrose density gradients, radioactive precursor labeling, and autoradiographic procedures. It was found that irradiation reduced protein synthesis within a 2-hour period while a depression of RNA synthesis by x-irradiation was evident somewhat later. Rapidly labeled ribosome precursor RNA was delayed in its transformation into smaller RNA molecules as revealed by pulse chase experiments at a time when inhibition of total RNA synthesis becomes noticeable after 2000 Rads of x-irradiation. Specific activities of polysomal fractions from irradiated and control cells labeled with radioactive amino acids are almost identical, but the total amount of radioactivity was less in the sedimentation profile of irradiated cells than in controls. Several possible mechanisms that could result in the depression of protein synthesis are discussed. (auth)

31855 EFFECTS OF X-RADIATION ON AMINO ACID INCORPORATION INTO REGENERATING LIVER PROTEINS. Ariyama, K.; Fausto, N.; Tamvakopoulos, E.; Van Lancker, J. L. (Brown Univ., Providence). Radiat. Res.; 42: 528-38(Jun 1970).

The effect of x-radiation on some components of the nuclear and cytoplasmic machinery for protein synthesis was investigated. The incorporation of ^{14}C-leucine and ^{14}C-lysine into nuclear and cytoplasmic proteins of irradiated and nonirradiated regenerating or normal rat liver was investigated. X-radiation interferes with the incorporation of ^{14}C-lysine (but not with ^{14}C-leucine) into nuclear proteins of regenerating liver. X-radiation also alters the incorporation of ^{14}C-lysine into isolated nuclei obtained from regenerating liver of irradiated animals. Microsomes and ribosomes obtained from regenerating livers of irradiated or nonirradiated animals were equally efficient in contributing to amino acid incorporation into protein in standard incubation mixtures. Nuclear RNA extracted with hot phenol from irradiated or nonirradiated regenerating liver, stimulates amino acid incorporation in vitro to the same degree whatever its source. The results suggest that the alteration in protein synthesis produced by x-radiation is caused by a decrease in the production of nuclear RNA and possibly, specific types of messenger RNA. (auth)

31856 RADIATION CHEMISTRY OF AMINO ACIDS. Getoff, N. (Oesterreichische Akademie der Wissenschaften, Vienna. Reaktorzentrum, Seibersdorf, Austria). pp 215-31 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

A review of the radiation chemistry of the amino acids in aqueous solutions is presented. For a better understanding of the reaction mechanisms the radiolysis of water is first briefly referred to. The typical radiation-induced decomposition reactions in deaerated and in oxygenated aqueous solutions are then discussed. In addition to this, the action of the primary products of water radiolysis on the sulfur-containing amino acids as well as on the aromatic and heterocyclic amino acids is described. For completion of the subject some typical data concerning the formation of amino acids under the influence of radiation are also reported. Finally, the achievement for a better understanding of the reaction mechanisms of amino acids by the use of ESR and pulse radiolysis techniques is mentioned. (auth)

31857 RESIDUAL INFECTIVITY AND THE EXTENT OF PHOTOREACTIVATION IN THREE DIFFERENT HOST PLANTS OF U.V.-IRRADIATED POTATO VIRUS X. Govier, D. A.; Kleczkowski, A. (Rothamsted Experimental Station, Hertfordshire, Eng.). J. Gen. Virol.; 4: 347-54(Apr 1969).

Residual infectivities of uv irradiated preparations of potato virus X were assayed on three different kinds of plants. When the plants were kept in darkness to prevent photoreactivation of the inactivated virus, the residual infectivity appeared the same whether Chenopodium amaranticolor or either of two varieties of tobacco was used for assay. When the plants were exposed to daylight, photoreactivation occurred in all three kinds of plants, possibly to a somewhat greater extent in Chenopodium than in tobacco plants. Thus, in contrast to the results previously obtained with tobacco necrosis virus, no evidence was obtained for dark reactivation of uv inactivated potato virus X in Chenopodium. In the absence of photoreactivation, the quantum yields for inactivation were about 0.8×10^{-3} and 1.3×10^{-3} for the whole virus and for the RNA inside the virus, respectively. (auth)

31858 INACTIVATION AND MUTAGENESIS ON ISOLATED DNA. V. THE IMPORTANCE OF REPAIRING ENZYMES FOR THE INACTIVATION OF TRANSFORMING DNA IN VITRO. Bresler, S. E.; Kalinin, V. L.; Perumov, D. A. (Inst. of High Molecular Weight Compounds, Leningrad). Mutat. Res.; 9: 1-19(Jan 1970).

The role of repair enzymes in the inactivation rate of transforming DNA was studied. Comparative studies were carried out on recipient strains with and without dark repair (hcr^- and uvr^-). Pronounced dark repair was found for lesions induced in vitro in DNA by uv irradiation, nitrous acid, dimethyl sulfate and N-methyl-N'-nitro-N-nitrosoguanidine. On the other hand, after treatment with hydroxylamine and pancreatic deoxyribonuclease the residual transforming activity was the same when assayed on uvr^+, uvr^- or hcr^- as hosts. Recombinogens (moderate uv irradiation and mitomycin C) were used on recipient cells to enhance genetic recombination and the rescue of genetic markers during transformation. Both effects changed in parallel as a function of the recipient cells' survival. A quantitative estimation shows that the rescue of inactivated DNA is due partly to DNA repair and partly to increased recombination frequency. Finally, photoreactivating enzyme from baker's yeast was shown to act not only on inactivating damage induced in transforming DNA by uv irradiation, but also on mutational events generated by irradiation in vitro. This observation confirms that pyrimidine dimers are the main lesions in both conditions. (auth)

31859 SYNTHESIS OF RNA IN UV-IRRADIATED E. COLI INFECTED WITH BACTERIOPHAGE ϕX174. Palchaudhuri, S. R. (Carleton Univ., Ottawa). Sci. Cult. (Calcutta); 35: 355-8(Jul 1969).

A method for isolating ϕX-specific synthetic processes from those of the host cells (E. coli) by specifically inhibiting host rRNA by uv radiation and infecting them with healthy phages is described. Latent periods and corresponding RNA synthesis between photoreactivation and dark repair of uv-irradiated cells were compared. Total RNA synthesis of uv-irradiated cells infected with unirradiated ϕX174 in light and dark showed that photoreactivation did occur. Synthesis of RNA in irradiated cells infected with healthy phage during photoreactivation was also observed. (C.O.)

31860 RADIATION INDUCED BREAKS INCREASE THE PRIMING ACTIVITY OF RAT SARCOMA DNA IN THE DNA POLYMERASE REACTION. Dalrymple, Glenn V.; Sanders, J. L.; Moss, A. J. Jr.; Wilkinson, K. P. (Univ. of Arkansas Medical Center, Little Rock. Veterans Administration Hospital, Little Rock, Ark.). Biochem. Biophys. Res. Commun.; 39: 538-43 (11 May 1970).

Radiation produces large numbers of DNA breaks that are characterized by 5' termini. The presence of these breaks is accompanied by an increase in the ability of the DNA to serve as a primer in the DNA polymerase reaction. Since DNA polymerase adds nucleotides from the 3' end of the molecule, and since a 3' OH terminus is required, our results provide additional evidence that some radiation induced DNA breaks are characterized by 5' PO_4—3' OH termini. DNA ligase is very likely responsible for rejoining this type of break. (auth)

31861 CHROMATOGRAPHIC STUDY OF IRRADIATED PLASMA LECITHINS. Dousset, N.; Douste-Blazy, L. (Hospital La Grave, Toulouse). Bull. Soc. Chim. Biol.; 51: 1013-20(23 Oct 1969). (In French).

Plasma lipids were fractionated from human blood by the method of Burstein using dextran sulfate, and the α-lipoprotein fraction was lyophilized. Five g of this powder (≈10 ml serum) was irradiated with a 20,000-rad dose of 100-kv x rays. Such irradiation of plasma-α-lipoproteins resulted in the formation of lecithins with increased polarity that made them comparable to lysolecithins in this respect. The two phospholipids showed identical Rf values in the usual solvents of phospholipids on thin-layer chromatography. Altered lecithins were separated from lysoderivatives by double dilution chromatography. Gaseous phase chromatography made it possible to demonstrate that the effect

of ionizing radiation on plasma lecithins results consistently in a shortening of the chain of unsaturated fatty acids, mainly oleic, linoleic, and arachidonic acids. The appearance of short acyl chains is concomitant with the formation of aldehyde and acid derivatives as demonstrated by gaseous phase chromatography. (BBB)

31862 RIBOSOMES OF PEAR FRUIT. THEIR SYNTHESIS DURING THE CLIMACTERIC AND THE AGE-RELATED COMPENSATORY RESPONSE TO IONIZING RADIATION. Ku, Lily Lim; Romani, Roger J. (Univ. of California, Davis). Contract AT(11-1)-34. Plant Physiol.; 45: 401-7(Apr 1970). (UCD-34-P-112-36).

Maceration at liquid nitrogen temperatures, use of polyvinylpyrrolidone, and careful pH control are essential to the isolation of ribosomes and polysomes from deciduous fruit tissue. Characteristics of the ribosomes and constituent RNA are described. The distribution of ribosomes among monomer and polymer forms remains relatively constant until fruit reach the climacteric peak, after which there is a notable decline in the polymeric forms. In contrast to the relative stability in size distribution there is a marked change in ribosomal turnover during the climacteric rise. A transitory increase in rate of ribosomal synthesis is followed by a rapid decline coincident with the final portion of the climacteric rise. No incorporation of radioactive base into ribosomes could be detected once fruit had reached the climacteric peak. Coincidence of radioactivity with the ribosomal RNA on methylated albumin-Kieselguhr chromatograms and complete inhibition of ribosomal RNA synthesis by actinomycin D confirm that radioactive nucleotide was incorporated into newly synthesized ribosomes. Data are presented to distinguish between a cellular response to injury, as may result from the preparation of tissue slices, and the effects of physiological age. Superimposed intracellular radiation injury stimulates the synthesis of new ribosomes and underscores a major transition in the dynamics of the ribosomal system coincident with the climacteric rise. (auth)

31863 RELEASE OF HYPOXANTHINE FROM X-IRRADIATED RAT THYMOCYTES. Araki, Kimiko; Taguchi, Shigetoshi; Ohyama, Harumi; Yamada; Takeshi (National Inst. of Radiological Sciences, Chiba, Japan). Int. J. Radiat. Biol.; 17: 375-80(1970).

An attempt was made to identify the catabolic metabolite of adenine nucleotides in x-irradiated thymocytes. Hypoxanthine began to be released into the extracellular medium in the early phase of 2 hours' incubation at 37°C with glucose after irradiation. The amount was dependent on x-ray doses ranging from 0·5 kR to 32 kR and may possibly explain the loss of the adenine nucleotides after irradiation. (auth) (UK)

Immunology

Refer also to abstracts 31896, 31907, 32073, 32176, and 32182.

31864 (ORNL-4558, pp 43-7) ANTIGEN RECOGNITION: EXPERIMENTAL DETERMINATION OF THE NUMBER OF LYMPHOCYTES THAT WILL RESPOND TO A SINGLE ANTIGEN. Davis, M. L.; Anderson, N. G. (Oak Ridge National Lab., Tenn.).

Intravenous injections of allogeneic and syngeneic lymph node lymphocytes were given to x-irradiated mice. After 24 hrs the mice given allogeneic lymphocytes showed an increase in the number of large lymphocytes in the lymphatic follicles and an associated loss of small and medium lymphocytes. Mice given syngeneic lymphocytes did not show cellular transformation in the lymphoid tissues during the first six days after cell inoculation. The lymphatic organs of irradiated, noninjected control mice showed maximal lymphocyte depletion by the fourth day after radiation exposure, and no signs of lymphocyte repopulation were observed during the following seven days. It was concluded that a large fraction of the lymphocyte pool in the normal mouse is capable of undergoing a recognition response when exposed to a single antigen. (H.L.W.)

31865 EFFECT OF IONIZING RADIATION ON INFECTION AND IMMUNITY IN FARM ANIMALS. Pritulin, P. I.; Gorbatov, V. A. Tr. Vses. Inst. Eksp. Vet.; 35: 144-59(1968). (In Russian).

Experiments on farm animals (calves, swine, sheep) and laboratory animals (rabbits, guinea pigs, white mice) exposed to ionizing radiation (IR) showed that IR lowers the protective barrier functions and inhibits the phagocytic reaction to various pathogens. Ionizing radiation also intensifies the pathogenic properties of commensal microbes, i.e., endogenous infection. The restoration of resistance to the agents following exposure to IR occurred at different times, depending on the nature of the IR. Endogenous infections in irradiated animals resulted from smaller doses of infectious material, developed more rapidly, and exhibited characteristic features. The strength of active and passive immunity after irradiation decreased in relation to the dose (the larger the dose, the lower the effectiveness of sera). The periods of decrease in passive immunity and maximum reduction in number of leukocytes coincided. Inhibition of phagocytosis is considered one of the reasons for the decrease in passive immunity. The suppression of immunogenesis is linked primarily to impairment of protein synthesis, specifically, synthesis of gamma globulins and nucleic acids. (JPRS)

31866 RADIOTHERAPY AND IMMUNE REACTIONS OF SPLEEN CELLS IN EXPERIMENTAL TUMORS. Juliani, G.; Cirillo, R.; Ballaira, L.; Fava, C. (Univ., Turin). Minerva Radiol.; 14: 494-8(Nov 1969). (In Italian).

The in vitro cancerolytic effect on Ehrlich tumor cells on the part of spleen cells obtained from animals affected with the same tumor was studied. Irradiation of the solid form tumor in donor mice potentiates the cytolytic effect, whereas treatment with an immunosuppressor, methotrexate, or whole-body irradiation decreases it. (auth)

31867 SURFACE ANTIGEN(s) OF SV40-TRANSFORMED TUMOR CELLS. Haeyry, Pekka; Defendi, Vittorio (Wistar Inst. of Anatomy and Biology, Philadelphia). Virology; 41: 22-9(May 1970).

Cells transformed by SV40 virus acquire new antigens on the cell surface. One of these antigens, designated as surface, or S, antigen, has been demonstrated with serological tests, such as the mixed hemagglutination (MHA) or indirect immunofluorescence (IF). While confirming our original observations on the specificity of the immunological changes, we found evidence that the serologically detected neoantigen(s) on the SV40-transformed cell surface were not virus-specific products, but rather components of the normal cell surface exposed by a virus-specific "uncovering" mechanism. Cell lines transformed spontaneously or by polyoma virus, as well as nontransformed lines, can be converted from an MHA or IF nonreactive to a reactive state by mild short-term treatments with certain proteolytic enzymes. The antigen(s) thus exposed crossreact with the antigen(s) on the SV40-transformed cell surface, as demonstrated by MHA or IF tests and cross-adsorption studies, regardless of the species of origin of the line. Although it has not been possible to define the nature of the antigen(s) concerned, it is unlikely that the antigenic specificity is determined by hematoside or H-acetylglucosamine or that it crossreacts with Forssman antigen(s). (auth)

31868 IMMUNOCOMPETENT CELL FUNCTIONS IN MICE INFECTED WITH FRIEND LEUKEMIA VIRUS. Bennett, Michael; Steeves, Richard A. (Roswell Park Memorial Inst., Buffalo). J. Nat. Cancer Inst.; 44: 1107-19(May 1970).

Immunocompetent cell functions were evaluated in mice infected with a preparation of Friend leukemia virus complex (FV) that induces spleen focus formation and polycythemia. FV infection did not impair graft-versus-host reactions, irrespective of whether donor or host mice were infected. Also, alloantigen-sensitive units, which proliferate on exposure to foreign histocompatibility antigens, were not impaired by FV infection. Cells responsible for rejection of hematopoietic allografts in irradiated mice were similarly unaffected. Antigen-sensitive units of lymph nodes responsive to sheep red-blood cell antigens and leading to the formation of hemolytic plaque-forming cells were suppressed by FV infection. The thymic component of antigen-sensitive units, called antigen-reactive cells, was not functionally impaired. However, marrow precursors of plaque-forming cells were markedly suppressed by FV infection. Therefore, FV infection selectively affected precursors of humoral antibody-producing cells. Suppression apparently did not require continued presence of virus, since this effect was detected in infected marrow cell preparations after incubation with Friend antiserum. Immunosuppression was unaffected by previous adrenalectomy, which suggested that the effect was not mediated by adrenal hormones. Cortisol, which also suppresses marrow precursors of plaque-forming cells, enhanced spleen focus formation in susceptible mice. Thus interaction between FV and immunocompetent cells analogous to these precursors was not required for viral induction of erythropoiesis. C57BL/10 mice, genetically refractory to most strains of FV, were not made susceptible to spleen focus formation by prior treatment with cortisol. Therefore, the cellular basis for this genetic refractoriness to FV does not reside in immunocompetent precursors, but probably resides in erythropoietic target cells. (auth)

31869 MEASUREMENT OF GRAFT-VERSUS-HOST REACTIONS ON THE CHORIOALLANTOIC MEMBRANE OF THE CHICKEN. Longenecker, B. M.; Sheridan, S.; Law, G. R. J.; Ruth, R. F. (Univ. of Alberta, Edmonton. Hy-Line Poultry Farms, Johnston, Iowa). Transplantation; 9: 544-57(Jun 1970).

Focal opacities or pocks form on the chorioallantoic membrane after inoculation with competent lymphocytes. Minor B_θ and major B histoincompatibilities can be discriminated by the sizes of the pocks (mean diameters of 0.32 and 1.02 mm). The number of minor B_θ pocks is directly proportional to graft-versus-host splenomegaly. The blood of donors differ greatly as initiators of large B pocks (from 1 to 5/mm³ of whole blood). This variation is associated with the B genotype of the donor but appears to be independent of the B genotype of the embryo. The number of large B pocks is reduced by x-irradiation or Mitomycin-C treatment of donor cells. The D_θ for x-irradiation is 94 R, identical with the D_θ for the suppression of haematopoietic colony-forming units, and the LD_{10} for Mitomycin-C, under standard conditions, is 6.3 μg/ml. Dilution of the inocula reduces the number of large pocks in direct proportion to the reduction in cell number. Neither genetic selection of the donor nor any of the treatments reduce the size of the pocks or delay their appearance. This indicates that each pock probably marks the site of an antigen-initiated proliferation of a single donor lymphocyte, entraining thereby the pathological changes which culminate in the formation of a visible pock. (auth)

31870 IMMUNOGENIC EFFECT IN DOGS OF DOUBLE VACCINATION WITH 40 Kr. X-IRRADIATED ANCYLOSTOMA CANINUM LARVAE. de Leon-Dancel, D.; Lopez-Alberty, J. C.; Rivera-Anaya, J. D. (Jensen-Salsbury Labs., Kansas City, Mo.). J. Agr. Univ. Puerto Rico; 54: 192-4(Jan 1970).

Ten dogs were given two subcutaneous doses of vaccine containing Ancylostoma caninum larvae x-irradiated at 40 kr. These dogs and ten control dogs were then exposed to hookworm infection. All of the vaccinated and control dogs died of ancylostomiasis nine to twelve days after exposure. A mean worm count in vaccinated and control dogs indicated a 16% protection in vaccinated dogs. (H.L.W.)

31871 EXPERIMENTAL VACCINATION OF BULLS WITH X-IRRADIATED DICTYOCAULUS VIVIPARUS LARVAE. IV. SERUM PROTEIN CHANGES IN CALVES VACCINATED AND INFECTED WITH DICTYOCAULUS VIVIPARUS LARVAE. Hampl, Jaroslav; Prochazka, Zdenek; Tomanek, Josef (Veterinary Research Inst., Brno). Doc. Vet.; 7: 253-9(1968).

A study was made on serum protein changes in 45 male calves vaccinated with radiation vaccine against Dictyocaulus viviparus infection of cattle. The vaccinated calves showed an increase in all globulin fractions whereas on revaccination only a marked increase in gamma globulin was observed. The preponderance of globulin formation was also manifested by the A/G quotient which in the vaccinated calves decreased markedly up to the 3rd week, then gradually increased and returned to the initial values at 5 weeks. The infected group showed a persistent increase in total protein which was observed in the control animals as well as in the vaccinated ones but this change was not associated with any marked deviations in serum protein fractions. When challenged with 10,000 larvae per os, the vaccinated and unvaccinated groups showed no persistent significant changes in the serum protein fractions. (auth)

31872 LOSS OF TRANSPLANTABILITY AND INDUCTION OF IMMUNOPROTECTION BY MOUSE ASCITES TUMOR CELLS IN TISSUE CULTURE. Morgan, J. F.; Eng, C. P.; Heuchert, M. D.; Kirk, H. D. (Univ. of Saskatchewan, Saskatoon). Proc. Soc. Exp. Biol. Med.; 134: 305-8(May 1970).

A tumor model system has been developed based on the loss of transplantability by long-term cultures of ascites tumor cells. Nontumorigenic 6C3HED cells were completely unable to produce tumors in both normal and x-irradiated mice. Some recovery of transplantability was achieved by suspending nontumorigenic 6C3HED cells in sterile-filtered ascites fluid from Ehrlich–Lettré tumor. The nontumorigenic 6C3HED cells proved highly immunoprotective in mice since they induced complete protection against challenge with 10^6 virulent cells. (auth)

31873 GRAFT-VERSUS-HOST REACTIONS IN NONIRRADIATED MICE. EARLY SUPPRESSION OF JERNE PLAQUES AND HEMOPOIETIC COLONY-FORMING UNITS. Davis, William E. Jr.; Cole, Leonard J.; Schaffer, Walter T. (Naval Radiological Defense Lab., San Francisco). Transplantation; 9: 529-37(Jun 1970).

The effect of graft-versus-host (gvh) reactions was studied at the cellular level. It was found that splenic plaque-forming cells (pfc) and hemopoietic colony-forming units (cfu) of nonirradiated adult F_1 hybrid mice were inhibited following injection with parental strain lymph node cells (10^7). Suppression of pfc was evident 3 to 6 days after injection and there was only 1% of the control pfc level by 10 days. It was found that the donor lymph node cells did not contribute significantly to the remaining pfc response. Colony-forming units were depressed in the spleen by 12 days or earlier if larger numbers of parental lymph node cells (4.7×10^7) were injected. Suppression of cfu in the bone marrow was not noted during the 12-day interval studied. These results may be interpreted as evidence that pfc precursor cells and/or cfu are primary targets of the gvh reaction, but other indirect mechanisms, which are discussed, are not necessarily excluded. (auth)

31874 MACROPHAGES, LYMPHOCYTES, AND ANTIBODY FORMATION. Feldman, M. (Weizmann Inst. of Science, Rehovoth, Israel). Antibiot. Chemother.: 15: 56-63(1969).

Studies to test whether the processing of antigen by macrophages is an essential step in the induction of antibody production were reviewed. They were initiated following observations on the kinetics of the induction of tolerance to human serum albumin (HSA) in x-irradiated rabbits. Rabbits exposed to 550 R total-body x irradiation, then injected during the recovery period with otherwise immunogenic doses of HSA, acquired specific immunological tolerance to HSA. The animals remained susceptible to tolerance induction 4 weeks following exposure to x rays. Furthermore, it seemed that smaller amounts of antigen were required for the induction of tolerance when antigen treatment was begun 4 weeks after irradiation, than when the same treatment was initiated after 24 hr. The histogenetic regeneration of the antibody-forming organs was practically complete at 4 weeks after x irradiation, and the circulating lymphocytes, which decreased sharply after x irradiation, regained normal levels within 3 weeks following exposure, even rising above the mean normal in the second month post-irradiation. Therefore, the lymphoid system per se may recover in advance of the recovery of immunocompetence. Accordingly, regeneration of immune competence following irradiation depends not only on regeneration of lymphocytes, but also on the postirradiation recovery of another cell type, presumably the macrophage. Whether macrophages from normal mice, after interacting in vitro with Shigella antigen, will evoke antibody production in mice exposed to sublethal doses (550 R) of total-body x irradiation was tested. Results showed that lymphocyte-free macrophage populations, obtained following in vitro culturing of peritoneal cells, induced the production of antibody in irradiated recipients. Primed macrophages could elicit antibody production in x-irradiated mice across H-2 barriers; their immunogenic effect was, however, completely inhibited if the recipients were previously sensitized against the prospective donors. In vitro irradiation, similar to irradiation of the whole animal, abolished the capacity of macrophages to signal antibody production. Inactivation of the processing capacity of macrophages by x rays could not be attributed to the suppression of the capacity of macrophages to take up antigenic material; thus, irradiation impaired the processing of antigen within the cells in an unknown manner. In vitro experiments with Shigella suggested that normal macrophages triggered the production of anti-Shigella antibodies by lymphocytes which, following irradiation, had regenerated and achieved immune competence due to the inductive effect of the thymus. (BBB)

31875 RADIOIMMUNOASSAY OF PLASMA ESTRONE AND ESTRADIOL. Mikhail, G.; Wu, C. H.; Ferin, M.; Vande Wiele, R. L. (Jefferson Medical Coll., Philadelphia. Columbia Univ., New York). Steroids; 15: 333-52(Mar 1970).

Estradiol-17β-succinyl-BSA was used as an antigen to produce antibodies to estradiol (E_2). The antibodies did not cross react significantly with other steroids except estrone (E_1) and was used in the development of a radioimmunoassay for E_1 and E_2. Following purification with rivanol, the antibodies were polymerized using ethyl chloroformate. Tracers were added to the plasma before extraction and Sephadex LH-20 column chromatography was used to separate E_1 from E_2. After incubation with polymerized antibodies which were mixed with ^3H-E_1 or ^3H-E_2, the free and protein bound fractions were separated by centrifugation. Sample concentrations were obtained from reference standard curves. The water blank of the method is 11 ± 1 picograms (pg). The lower limit of sensitivity is 50 pg. The coefficient of variation for measurement of plasma estrone and estradiol was 8 to 18% and 4 to 17% respectively. (auth)

31876 RADIOIMMUNOASSAY FOR PLASMA ALDOSTERONE. Mayes, D.; Furuyama, S.; Kem, D. C.; Nugent, C. A. (Univ. of Hawaii, Honolulu). J. Clin. Endocrinol. Metab.; 30: 682-5(May 1970).

The properties of antibodies to steroid-protein conjugates were investigated many years ago by Lieberman and his coworkers. Recently antibodies to an estradiol-protein conjugate have been used for assay of estradiol in human plasma. This report describes a method, using antibodies to an aldosterone-protein conjugate, to measure aldosterone in extracts of plasma purified by one column and one paper chromatography. (auth)

31877 APPENDIX AND γM-ANTIBODY FORMATION. I. IMMUNE RESPONSE AND TOLERANCE TO BOVINE γ GLOBULIN IN IRRADIATED, APPENDIX-SHIELDED RABBITS. Hanaoka, M.; Nomoto, K.; Waksman, Byron H. (Yale Univ., New Haven). J. Immunol.; 104: 616-25(Mar 1970).

Intravenous injection of 200 μg of alum-precipitated bovine γ globulin into x irradiated (900 R) rabbits, whose appendix and bone marrow had been shielded during irradiation, gave rise to an early hemagglutinin response predominantly of the γM immunoglobulin type. This effect was exaggerated by direct injection of antigen into the appendiceal artery or into the lumen of the appendix. Injection by either route of antigen freed of aggregated material by centrifugation gave little immune response and appeared to inhibit formation of γM antibody on subsequent challenge with alum-precipitated antigen. Late formation of γG antibody and the development of memory (ability to give an early γG response after secondary challenge) were not affected by irradiation of the appendix, but were inhibited in animals whose bone marrow was not shielded during irradiation. (auth)

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Refer also to abstracts 31783 and 31963–31967.

31878 (BNWL–1050(Pt.2)) ANNUAL REPORT, 1968. VOLUME I. LIFE SCIENCES. PART 2. ECOLOGICAL SCIENCES. Pearce, D. W. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1969. Contract AT(45-1)-1830. 130p. Dep. CFSTI.

Separate abstracts were prepared for eight papers. An additional fifteen papers are included on various aspects of aquatic and terrestrial ecology. (H.L.W.)

For abstracts of individual papers see: 31879–31886.

31879 (BNWL–1050(Pt.2), pp 1.13-15) SIMILARITY-RATIO FOR RADIONUCLIDE RETENTION. Eberhardt, L. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

It is suggested that log-log interspecies comparisons of radionuclide retention time and body size are misleading; and it is shown that scaling body weights by the $^3/_4$ power (metabolic body size) yields a new similarity-ratio between different species. (auth)

31880 (BNWL–1050(Pt.2), pp 1.15-17) MODELING RADIONUCLIDE TRANSFER IN FOOD CHAINS. Eberhardt, L. L.; Hanson, W. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A two-avenue approach to understanding food chain processes has produced a series of structural models for variations on an input-output scheme and combined the details of component processes into an overall computer simulation of a simple food-chain model. (auth)

31881 (BNWL–1050(Pt.2), pp 1.20-3) RADIONUCLIDE DISTRIBUTION IN THE ALASKAN ARCTIC ECOSYSTEM. Jenkins, C. E.; Hanson, W. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Eighteen γ-emitting natural and artificial radionuclides were measured in the Arctic biosphere. The comparison of the accumulation of radionuclides in plant and animal tissues shows distinct variations and differences in the behavior of these individual radioelements. Generally, retention of these radionuclides was found to be location and species dependent in lichen and sex and age dependent in caribou. (auth)

31882 (BNWL–1050(Pt.2), pp 1.23-5) ESKIMO FOOD CHAIN STUDIES. Hanson, W. C.; Eberhardt, L. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Five measurements of ^{137}Cs body burdens of native residents of three Alaskan villages during the period December 1967 to October 1968 described a normal seasonal pattern at Arctic Village and unusual patterns at Anaktuvuk Pass and Ambler. The patterns are compared with the preceding six measurements, during which an opposite relationship occurred. (auth)

31883 (BNWL–1050(Pt.2), pp 1.25-8) RADIOCESIUM IN CUTTHROAT TROUT INHABITING A CASCADE MOUNTAIN BOG. Richard, W. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

In a mineral deficient bog, small but measurable amounts of fallout-derived radiocesium were detected in macrophytes and trout. Changes in concentration of radiocesium by season were not readily apparent in trout or macrophytes. (auth)

31884 (BNWL–1050(Pt.2), pp 2.5-7) THERMOLUMINESCENT DOSIMETRY IN COLUMBIA RIVER ORGANISMS. Watson, D. G.; Templeton, W. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

LiF thermoluminescent dosimetry appears to be a practical means of measuring radiation dose of aquatic organisms in their natural environment. Highest measurements were observed in the benthos; and external radiation was a significant contributor to the total in fish. Dose to fish from contained radionuclides may be inversely related to body weight. (auth)

31885 (BNWL–1050(Pt.2), pp 2.13-15) SEASONAL VARIATION IN RADIONUCLIDES IN COLUMBIA RIVER ORGANISMS. Watson, D. G.; Cushing, C. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The spring-early summer high-water flow in the Columbia River results in two effects upon the seasonal concentrations of radionuclides in the biota, namely a dampening of increasing concentrations in early spring as light and temperature become metabolically favorable, and low summer levels as a result of dilution of ambient radionuclide concentrations. (auth)

31886 (BNWL–1050(Pt.2), pp 2.16-19) ^{65}Zn CYCLING IN PERIPHYTON. Cushing, C. E.; Rose, F. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Cycling of ^{65}Zn by periphyton was followed in the field and under controlled conditions in the laboratory. Accumulation appears to result from adsorption to cellular surfaces because uptake is similar in living and killed communities and rates of uptake are directly related to ambient concentration. However, regulation of the photoperiod produced a marked effect on uptake. Field data support the laboratory results and indicate that the isotope is rapidly lost when the ambient concentration is suddenly reduced. (auth)

31887 (CEA-CONF–1431) STUDY OF THE BEHAVIOR OF RADIOCOBALT IN SIMPLE ARTIFICIAL ECOSYSTEM IRRIGATED BY SUBMERSION. Bittel, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires); Merlini, M.; Myttenaere, C.; Bourdeau, Ph. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). [1969]. 27p. (In French). (CONF-690918-4). Dep. CFSTI (U. S. Sales Only).

From Conference on Radioecology, Cadarache, France.

Radioisotopes of cobalt, especially ^{60}Co, occur in liquid effluents of installations for decontamination of irradiated material. They may occur in a saline state or in complexes with various chelating agents such as EDTA. For the present study, ^{60}Co was introduced either in a simple ionic state or complexed with EDTA into an artificial rice field constructed in a greenhouse under conditions resembling actual irrigation. The freshwater bivalve, Unio mancus elongatus, was then introduced. A double isotope technique (^{60}Co in irrigation water, ^{58}Co in the soil) was used to study the behavior of cobalt in the soil, the water, and the organisms. Results showed that there was a preponderant selection of water cobalt by the organisms in relation to soil cobalt. There was a preponderant selection of cobalt introduced in the simple ionic state, while migration of cobalt occurred primarily in the complex form. Hazards of contamination of irrigation ecosystems are discussed, and it is pointed out that cobalt complexes are more significant than simple ionic cobalt in the migration of cobalt. (H.L.W.)

31888 (COO–651-72) SURVEY OF ENVIRONMENTAL RADIOACTIVITY, JULY–DECEMBER 1968. (Minnesota Dept. of Health, Minneapolis. Rural Cooperative Power Association, Elk River, Minn.). Apr 1969. Contract AT(11-1)-651. 38p. Dep. CFSTI.

Results of fallout monitoring studies in Minnesota from July through December, 1968, are reported. Data are presented on gross β radioactivity in samples of atmosphere, lake and river waters, and precipitation, the content of ^{137}Cs, ^{131}I, and ^{90}Sr in milk samples, and the content of tritium in samples of surface water. (C.H.)

31889 (COO–2044-1) $^{210}PoO_2$ METABOLISM IN RUMINANTS. First Technical Progress Report, May 1, 1969–January 15, 1970. Watters, R. L.; Johnson, James E. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). 29 Jan 1970. Contract AT(11-1)-2044. 25p. Dep. CFSTI.

Pilot experiments with dairy cattle have shown that the gut absorption of unsupported ^{210}Po and the subsequent transfer to milk is great enough to consider this pathway in a hazards analysis of environmental ^{210}Po contamination. Experiments are described to evaluate the transfer to milk under acute and chronic intake conditions. Excretion is primarily via feces in the rumi-

nant. Analysis of blood components have shown preferential binding on cell membranes. (auth)

31890 (NIRS-RSD-22, pp 1-12) DATA OF ROUTINE SURVEY. (National Inst. of Radiological Sciences, Chiba (Japan)).

Routine survey data are presented in four parts: meteorological data (^{137}Cs and ^{90}Sr monthly and cumulative deposits and radionuclide concentration in airborne dust); geographical data (^{144}Ce, ^{137}Cs, ^{106}Ru, and ^{90}Sr in soil and river sediments); water data (^{144}Ce, ^{137}Cs, ^{106}Ru, and ^{90}Sr in source water and treated water); and dietary data (^{137}Cs and ^{90}Sr in rice and ^{90}Sr in wheat). Graphs, maps, and tables are used in the presentation of data. (C.O.)

31891 (SZS-7/69) ^{90}Sr IN SOILS AND ^{90}Sr AND ^{137}Cs IN PLANTS OF THE TERRITORY OF THE G.D.R., 1967. Bose, Helga (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Jul 1969. 18p. (In German). Dep. CFSTI (U. S. Sales Only).

The results of ^{90}Sr determinations in soil and plant samples as well as the results of ^{137}Cs determinations in mixed ashes of plants sampled in 1967 are presented. The course of contamination is figured back to the year 1961. The ^{90}Sr contamination of meadow soils was 27.8 nCi/m^2 and that of arable soil was 31.4 nCi/m^2. For the first time a significant decrease (1966: 36.7 and 37.2, resp.) occurred. The investigation of the soil profiles of 4 meadow soils down to a depth of 50 cm did not show any increase of the ^{90}Sr concentration in the layers below 15 cm. The ^{90}Sr contamination of plants, which was between 41 and 82 percent of the values found in 1966, showed a more pronounced decrease than in the preceding year. No changes were observed for beets (body and tops). The ^{90}Sr content per kg dried matter was 1110 pCi/kg for cabbage (outer leaves), 787 pCi/kg for potato herb, 756 pCi/kg for red clover, 705 pCi/kg for beet tops, 702 pCi/kg for lucern, 582 pCi/kg for grass, 288 pCi/kg for beets, 212 pCi/kg for green maize, 32 pCi/kg for potatoes, 31 pCi/kg for rye grain, and 29 pCi/kg for wheat grain. Fallout retention by above ground plant parts was between 23 and 49%. The portions of ^{90}Sr taken up by plants from soil as well as the observed ratios hardly differed from values of last year. The $^{137}Cs/^{90}Sr$ ratio decreased in rye grain from 3 to 2 and in wheat grain and potatoes from 3 to 1 and remained constant in grass (1) and potato herb (0.2). (auth)

31892 (UCLA-12-772) EFFECT OF AMMONIUM NITRATE ON THE ^{90}Sr CONCENTRATION IN TOMATO ORGANS. Hawthorne, H. A. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). [1968]. Contract AT(04-1)-Gen-12. 23p. Dep. CFSTI.

Four calcareous and one acid soil were contaminated with ^{90}Sr, fertilized with ammonium nitrate, and used as substrate for tomato plants, (Lycopersicon esculentum) in a growth chamber. The free $CaCO_3$ content of the soils ranged from 0 to 33%; ammonium nitrate levels were 0, 100, 200, and 400 parts per million, as nitrogen. Significantly lower ($P < .001$) ^{90}Sr concentrations occurred in leaves of plants grown in unfertilized acid soil compared to those from acid soil fertilized with 100 parts per million nitrogen; these two nitrogen levels and soil resulted in plants with leaves having the minimum and the maximum observed concentrations of ^{90}Sr. Plants grown in calcareous soils, fertilized or unfertilized, had leaves with intermediate ^{90}Sr concentrations. The concentration of ^{90}Sr in stems was increased ($P < .001$) by increasing rates of nitrogen fertilization, as was the concentration in roots ($P < .005$). The concentrations in the plants were leaves > stems > roots in the approximate ratio of 5:3:2, respectively. The amounts of ^{90}Sr recovered from soils were variable because plant growth rates and tissue concentrations of ^{90}Sr were confounded, as shown by the high interaction term (nitrogen x soil) in the analysis of variance ($P < .005$). The minimum concentrations of ^{90}Sr occurred in plants from unfertilized acid soil, instead of in plants from high-calcium soils. This observation suggests that ^{90}Sr studies, in which acid soils were fertilized with nitrogenous materials before experimental treatments were instituted, may benefit from reassessment. The conclusions drawn from such studies may apply to an artifact of soil management, rather than to acid soils per se. (auth)

31893 OFFSITE RADIOLOGICAL SURVEILLANCE FOR PROJECT GASBUGGY, JUNE 1967-JULY 1968. McBride, John R.; Hill, Dixon (Southwestern Radiological Health Lab., Las Vegas, Nev.). Radiol. Health Data Rep.; 10: 535-46(Dec 1969).

Project Gasbuggy, an experiment to stimulate gas recovery by nuclear means, was conducted on December 10, 1967, as part of the Atomic Energy Commission's Plowshare program. The Public Health Service by Memorandum of Understanding with the AEC was responsible for a comprehensive offsite radiological safety program. The data obtained during this program documented that no radioactivity was introduced into the environment as a result of the Project Gasbuggy detonation. Surveillance of the El Paso natural gas producing wells near the Gasbuggy experiment was conducted to ensure that gas contaminated with radioactivity was not present. (auth)

31894 PULMONARY DOSE FROM ^{220}Rn RECEIVED BY INDIGENOUS RODENTS OF THE MORRO DO FERRO, BRAZIL. Drew, Robert T.; Eisenbud, Merril (New York Univ., N. Y.). Radiat. Res.; 42: 270-81(May 1970).

The Morro do Ferro, a hill in the State of Minas Gerais, Brazil, is characterized by natural levels of ionizing radiation that are the highest reported of any natural habitats. The external radiation levels range from 0.1 to 3.2 mR/hour. The average concentrations of ^{220}Rn and ^{212}Pb in rodent burrows are 27 nCi/liter and 23 pCi/liter. Because the dose to pulmonary tissue is highly dependent upon the metabolic fate of inhaled ^{212}Pb, laboratory experiments were performed to determine the distribution of this nuclide in the rat after exposure to ^{220}Rn and its daughters. The data obtained indicate that exposure to the average concentration of ^{220}Rn and its daughters in rodent burrows on the Morro do Ferro result in an annual dose from alpha radiation of about 100 Rads/year to the tracheal-bronchial epithelium and about 25 Rads/year to the alveolar epithelium. (auth)

31895 ENVIRONMENTAL SURVEY OF URANIUM MILL TAILINGS PILE, TUBA CITY, ARIZONA. Snelling, Robert N.; Shearer, S. D. Jr. (Southwestern Radiological Health Lab., Las Vegas, Nev.). Radiol. Health Data Rep.; 10: 475-87(Nov 1969).

At the request of the Navajo Tribal Council, an environmental radiological survey was conducted on the El Paso Natural Gas Company uranium tailings pile, Tuba City, Arizona, in May 1967. The purpose of the survey was to evaluate potential radiation hazards and to recommend methods of control. The survey included evaluation of external gamma radiation, airborne radioactivity, and waterborne radioactivity. The results indicate that the external radiation levels on the tailings area exceed recommended exposure limits for individuals in the general population. Wind carriage of the tailings in an easterly direction from the pile resulted in elevated radiation levels outside the controlled area. On the basis of these data it was recommended that the mill tailings be properly stabilized against wind erosion or periodic monitoring would be necessary. In May 1968, the pile was regraded and stabilized against wind erosion using a chemical binder. Because of the external radiation levels on the tailings area, this area was not released for public use. It was fenced and posted as a radiation area. The housing area was released to the Navajo Tribe and is presently occupied. (auth)

31896 RADIOIMMUNOASSAY FOR HUMAN THYROTROPIN. Miyai, Kiyoshi; Fukuchi, Minoru; Inoue, Tadashi; Abe, Hiroshi; Kumahara, Yuichi (Osaka Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 401-3(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A method for the radioimmunoassay of thyrotropin in human blood serum is described. The sensitivity of the method is discussed. (C.H.)

31897 RESEARCH FOR PUBLIC HAZARDS, USING ISOTOPE TECHNIQUE ON AQUATIC ORGANISMS. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 933-65(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Applications of radioisotopes as tracers in studies on the effects of contaminated marine environments on the public health of human populations are outlined. Studies on the mechanisms of bacterial contamination in fish and shellfish were conducted using ^{32}P-, ^{90}Y-, ^{203}Hg-, or ^{110}Ag-labeled bacteria or ^{131}I-labeled albumin aggregates; studies on the absorption of ^{106}Ru by the digestive tract of fish used ^{51}Cr-labeled chromic oxide as a tracer; studies on the toxicity of herbicides in a shell fish, Tapes philippinarum, used ^{14}C-labeled pentachlorophenate as the tracer; studies on the toxicity of organic Hg compounds in aquatic animals used ^{203}Hg- or double-labeled ^{14}C, ^{203}Hg-methylmercuric chloride, as the tracer; radioisotopes in radioactive wastes released to the sea were used as tracers for studies on the uptake and retention of Ce, Cd, Co, Cs, I, Sr, and Zn by marine organisms. (C.H.)

31898 ECOLOGICAL STUDY OF TWO APHID VECTORS OF THE SUGAR-BEET VIRUS. Francois, E.; Riga, A.; Impens, R. (Centre de Recherches Agronomiques de l'Etat, Gembloux, Belg.). pp 53-68 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In French).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

The dispersal of Myzus persicae Sulz and Aphis fabae Scop.

labeled with ^{32}P was studied from 1963 to 1965 in sugar-beet plots. The aphids were reared on beets infected with a virus causing severe yellowing and sprinkled with a solution containing 1 mCi of sodium orthophosphate (^{32}P). Aphids which remained for 24 hours on these plants were significantly labeled, as were also their first-generation descendants. The activity of the insects was recorded by a gas-flow detector with a low background. The radioactive beets infected with the virus and laden with aphids were placed in the center of the plots. After successively increasing dispersal times, the largest possible number of aphids was captured in each test, either manually or in traps. The coordinates and the precise identification of each labeled aphid were entered on charts, some of which are discussed by the authors. The experiments demonstrated the mobility of the apterae, which were found at average distances of 6.5 and 7 meters for Myzus persicae and Aphis fabae, respectively. However, some apterae of both species were found at distances of over 15 meters after the same period. The role of the winged species as virus carries over short distances should not be underestimated. The active character of both apterae and winged species is emphasized. (auth)

31899 INVASION OF CONIFER PLANTATIONS BY RADIOACTIVELY LABELLED HYLOBIUS ABIETIS L. Eidmann, H. H. (Royal Coll. of Forestry, Stockholm). pp 75-84 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Hylobius abietis L. weevils, radioactively labeled by dipping into solutions containing ^{46}Sc, were released around two model areas representing recently cleared cutting areas freshly planted with Norway spruce. Half of the weevils released around one model area were also labeled with different color marks. The invasion, of both the natural Hylobius population and the released labeled weevils, was studied by making repeated inspections of attractant pine billets evenly distributed over the experimental areas. At certain intervals the spruce plants on the areas were inspected for feeding marks to evaluate the progress of the attack. The greatest number of labeled weevils, amounting to 18% of those released, was found in one experimental area one day after release. In this area, successively diminishing numbers of weevils found at the billets (both labeled weevils and natural population) and an increasing degree of feeding on the plants indicated that the weevils did not leave the plantation but changed their behavior. The weevils often dug into the soil, which was proved by measurements of ground radioactivity at billets and stumps. In the other area, which had richer vegetation, only small changes in numbers occurred. In all inspections, most of the labeled weevils were found near the border of the experimental area, but the percentage of weevils in the middle of the area increased slowly. One day after release the greatest distance a radioactively-plus-color-labeled beetle had moved into the area was 34 m, while the average distance was only 4.15 m. There were no significant differences in the speed of invasion from different directions into the plantation. From the results and observations it can be concluded that most or all released weevils invaded the plantations by crawling, and not by flying. The natural populations invaded one experimental area slowly from the borders, and the other area faster and more evenly distributed. Accordingly, the distribution of damage by feeding was uneven in one area and comparatively even in the other. One practical consequence of this study is the recommendation that plant protection measures be concentrated on the borders of conifer plantations. Even plants in the central area of plantations should be protected. Concentrations of weevil-attracting materials, such as attractant insecticide traps, should be avoided in the centers of plantations. (auth)

31900 ADVANCES IN ENVIRONMENTAL SCIENCES. VOLUME 1. Pitts, James N. Jr.; Metcalf, Robert L. (eds.). New York; John Wiley and Sons, Inc. (1969). 361p. $15.95.

The nine chapters cover the following topics: outline of environmental sciences; the federal role in pollution abatement and control; our nation's water: its pollution control and management; oxides of nitrogen; the formation, reactions, and properties of peroxyacyl nitrates (PANS) in photochemical air pollution; biodegradable detergents and water pollution; aeroallergens and public health; catalytic removal of potential air pollutants from auto exhaust; and photochemical air pollution: singlet molecular oxygen as an environmental oxidant. (C.O.)

31901 ACCUMULATION AND RETENTION OF INGESTED ^{106}Ru BY GENUINE GOBY. Kimura, Ken-ichi; Ichikawa, Ryushi (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Suisan Gakkaishi; 35: 434-40(May 1969).

The accumulation and retention of ingested ^{106}Ru by a coastal sea fish when fed on contaminated food, and the transfer of this radionuclide through a food chain in a coastal sea environment, were studied to obtain information on the possible role of food-chain transfer of the nuclide in the radioactive contamination of marine organisms. The marine annelid worm, Nereis japonica, and genuine goby, Acanthogobius flavimanus, were used. The worms were placed in 2 l of seawater to which 24 μCi of ^{106}Ru, as nitrosyl ruthenium nitrate complex in nitric acid (Ru/N) or ruthenium chloride in hydrochloric acid (Ru/Cl). In another experiment, they were placed in 300 g of radioactive sandy mud through which radioactive seawater (24 μCi/2 l) flowed continuously and were maintained for 2 weeks at room temperature. About 0.1 g of annelid worm containing ^{106}Ru was administered orally to each fish with 13.2 g average body weight for 12 successive days and the retained radioactivity in the fish was then measured daily. The average uptake of ^{106}Ru following a single oral administration was ~5% of the administered dose in either Ru/N or Ru/Cl form. The apparent equilibrium condition was reached about 12 days after beginning the experiment. The body burden at this state was about 20% of the average daily dose. The concentration factor for the goby over annelid worm was about 0.002, and hence, the transfer of ^{106}Ru through this food chain was relatively small in comparison with the direct uptake from the surrounding seawater. (BBB)

31902 SOME ASPECTS OF ENVIRONMENTAL RADIOACTIVITY RESEARCH. Cigna, A. A. (CSN, Casaccia, Italy). Arh. Hig. Rada Toksikol.; 20: 25-38(1969).

The differences between the situation before and after the moratorium of nuclear tests in 1962 are analyzed. Such differences led to different approaches to the problem of radioactive environmental contamination. The representativity of the measurements is discussed from the point of view of both the time and the site of sampling. Due to either the low level or the absence of radioactive contamination, the actual trend of the research concerns the study of the distribution patterns and the behavior of stable elements in the biosphere. Different methods of analysis are considered and a survey into the capacity of each of them is presented. The contribution of the ecological research in the field of radiation protection is discussed. Some indicators are well-known by many researchers and proved to be valuable in the early detection of environmental contamination. The problem of the determination of the concentration factors is also considered. They play an important role in the establishment of the ecocycles of the radionuclides (fission and activation products) produced by nuclear power and research plants. The reference levels of the radioactive contaminations in the items of the food-chain can be determined taking into account both the concentration processes involved and the specific activity. The advantages of the different approaches are reported and discussed. Last but not least, the change in the radiation protection philosophy reported in the ICRP publication No. 7 is considered with the consequences in the development of the health physics techniques around nuclear plants. (auth)

Genetics and Cytogenetics

Refer also to abstracts 31840, 31858, 32173, 32203, 32204, 32268, 32276, 32279, 32320, and 32327.

31903 (STI/PUB-183) BIOLOGICAL EFFECTS OF TRANSMUTATION AND DECAY OF INCORPORATED RADIOISOTOPES. Panel Proceedings Series. Proceedings of a Panel Held in Vienna, 9-13 October 1967. (International Atomic Energy Agency, Vienna (Austria)). Jun 1968. 250p. (In French and English). (CONF-671036). IAEA $5.00.

The panel investigated the modes and mechanisms of transmutation and decay radiation events. Reports, reviews, and discussions were concerned with the role of physical and chemical factors of the decay of incorporated radioisotopes in producing injury to cells. They included past and current studies on mutation production, chromosome aberrations, macromolecular lesions, and cell survival. A summary of the general conclusions of the panel is also presented. Separate abstracts have been prepared for the 13 papers included in these proceedings. (M.M.B.)

For abstracts of individual papers see: 31432, 31436, 31798, 31856, 31922-31926, 32004, 32213, 32277, and 32278.

31904 (UCR-34-P-105-15) DIFFERENTIAL RADIOSENSITIVITY IN GERM CELLS OF DROSOPHILA. Progress Report for the Period 1969-1970. Parker, Dean R. (California Univ., Riverside). Contract AT(11-1)-34. 4p. Dep. CFSTI.

Doubly marked Y chromosomes in immature oocytes were irradiated; Y fragments were obtained and it was verified that these arose by interchange between the two arms of the Y. In contrast with this, only about 50% of fragments recovered from mature oocytes could be identified as to the kind of interchange producing

the fragment. X-ray induced recombination in the fourth chromosome showed a greater than linear dose response and occurred predominantly in the heterochromatic region spanning the centromere. Results were interpreted to indicate that interchange in the heterochromatic region, involving independently induced breaks, is an imprecise process leading to small heterochromatic duplications and deficiencies, and these variations in size and genetic content are reflected in the array of segregational behaviors found. A model for induced nondisjunction of chromosomes was used for predicting effects of interchange on segregation. Irradiated compound-X females having a Y chromosome produced a higher frequency of triplo-4 offspring than females lacking the Y. Studies on interchange in mature oocytes showed that the pattern of segregation is at least partially set by stage 14 and that a limit is set on the time during which distributive pairing relationships may be altered by interchange. (H.L.W.)

31905 (UCRL-19708) STIMULATION OF GENETIC RECOMBINATION AMONG LAMBDA BACTERIOPHAGES BY ULTRAVIOLET RADIATION: THE MECHANISM AND THE RELEVANCE OF DNA REPAIR PROCESSES. Baker, Raymond Milton (California Univ., Berkeley. Lawrence Radiation Lab.). Feb 1970. Contract W-7405-eng-48. 264p. Dep. CFSTI.

Thesis.

The stimulation of genetic recombination among λ bacteriophages by uv radiation has been studied in uv-sensitive and wild type E. coli K12 host bacteria. The uv enhancement of recombination frequencies was assayed for all progeny phages and for progeny that contained parental phage DNA strands labeled by means of host-controlled modification (HCM). The direct stimulation of λ recombination by uv-irradiation of the infecting phages is even greater in excision-defective bacteria, which are deficient in host cell reactivation (HCR) of the phages, than in wild type host cells. The uv lesions that promote recombination are repaired by HCR with the same efficiency as are potentially lethal lesions. The dose-response for uv enhancement of λ recombination is the same in HCR^+ recA and recB host bacteria which are deficient in their own recombination as in wild type REC^+ host strains. However, the uv survival of λ phages is somewhat lower in mutant recA cells than in wild type host bacteria. There is substantial multiplicity reactivation of uv lesions in phage λ. Under conditions of comparable recombination among the phages, the dose reductions caused by multiplicity reactivation of uv lesions are similar in HCR^+ and HCR^- host bacteria, but a much greater survival increase is evident in the HCR^- strains. The uv-induced recombination of λ proceeds by breakage and reunion of parental DNA strands. Light uv-irradiation of the infecting phages causes comparable increases in the frequencies of recombinants among all progeny phages and among progeny that contain HCM-labeled—λ·K12(Pl)—parental DNA strands. With increasing uv dose to the infecting phages there is a decreased recovery of progeny that retain a parental HCM label. The possible significance of this effect is discussed. The indirect enhancement of recombination among unirradiated λ phages caused by heavy uv-irradiation of the host bacteria was also examined. This effect is less marked than the direct enhancement caused by irradiation of the phage DNA itself. The indirect enhancement is apparently due to increased recombination by breakage and reunion of all phage genomes throughout the infection. It is observed for lower uv doses to excision-defective HCR^- host cells than to HCR^+ bacteria. This study also furnished information concerning uv-inactivation of the host capacity for λ phage. The experimental findings are considered with regard to possible mechanisms by which uv lesions might stimulate recombination. The preferred hypothesis is that uv-induced structural defects in DNA lead to an increased efficiency of pairing among chromosomes precedent to recombination by breakage and reunion. No evidence was found to imply that the uv-induced recombination is directly associated with any mode of DNA repair. (H.L.W.)

31906 THE MECHANISM OF CONJUGATION AND RECOMBINATION IN BACTERIA. VII. FURTHER CHARACTERISTICS OF RECOMBINATION-DEFICIENT Hfr MUTANTS. Włodarczyk, Miroslawa; Najer, Andrzej; Piekarowicz, Andrzej; Kunichi-Goldfinger, Wladyslaw J. H. (Warsaw Univ.). Acta Microbiol. Pol., Ser. A, 1: 123-4(1969).

The uv inducibility of λ prophage during recombination of normal F^- and deficient Hfr strains of Escherichia coli was studied. A new type of mutants of E. coli resistant to edeine is described in which various Hfr strains were deficient in their recombination capacity, at the same time being able to transfer their genophores into F^- cells without any hindrance. The analogous F^- mutants resistant to edeine were fully capable for recombination. The recombination deficiency in Hfr strains was not connected with any change in susceptibility to uv radiation. The edeine-resistance in Hfr cells is characterized by high reversibility. Susceptibility to edeine of those revertants is on the same level as susceptibility of wild strains. These revertants are, however, unable to undergo recombination. This shows that recombination-deficiency may be separated from edeine-resistance and is not correlated with it. Spontaneous and induced liberation of phage by $HfrH_0\lambda^+$ wild strain and its edeine-resistant (E^r) mutant was investigated. For induction, uv irradiation at doses allowing 20 to 30% survival was used. Results showed that there was no change in the level of spontaneous and uv-induced liberation of λ phage in recombination-deficient strains. The mutability of recombination-deficient strains was also unaltered in comparison with their parental-wild strains. It is evident that the recombination-deficiency in Hfr cells may not be attributed to the lack of an enzyme system operating in recombinational process. Presumably, recombination-deficiency is caused by some alteration in the tertiary structure of bacterial genophore. (BBB)

31907 OBSERVATIONS ON THE INACTIVATION OF NATIVE AND DENATURED STREPTOCOCCUS CHALLIS TRANSFORMING DNA BY UV, HNO_2, LOW pH, AND NITROSOGUANIDINE. Osowiecki, H.; Kaczanowska, J.; Dobrzanski, W. T. (School of Medicine, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Biol., 17: 95-100 (1969).

Marker inactivation was studied in transforming DNA of Streptococcus challis by comparison of the course of in vitro inactivation of 2 markers, resistance to streptomycin (Sm-r) and novobiocin (Novo-r), by uv, HNO_2, low pH, and N-methyl-N'-nitro-N-nitrosoguanidine (NTG). Experiments were also performed on single-stranded, heat-denatured DNA. A Westinghouse lamp G30T8 was used as a uv source. It was found that the two markers differ only slightly in uv sensitivity, but not in HNO_2 sensitivity. Inactivation curves of the two markers were similar. Transformation ability was decreased by uv and HNO_2 to a much higher extent in denatured as compared to native t-DNA of S. challis. The difference in sensitivity of markers in double-stranded and single-stranded DNA increased with increasing dose of mutagen. The Novo-r marker of H. influenzae is more uv resistant than the Sm-r marker. In H. influenzae the uv inactivation of the two markers is almost the same in single- and double-stranded DNA, but in S. challis the markers are much more resistant in native DNA. The Sm-r marker of D. pneumoniae is also more uv resistant in native than in heat-denatured DNA. A 60-min exposure to pH 4.1 did not lead to any differences in the course of inactivation of the Sm-r marker in native and denatured DNA. In native DNA at pH 2.0 the decrease was very rapid and linear. No inactivation of the Sm-r marker in native t-DNA of S. challis by NTG was observed, but NTG was found to induce Sm-r mutants in populations of the recipient S. challis in vivo. (BBB)

31908 PYRIMIDINE DIMER-INDUCED ENHANCEMENT OF RECOMBINATION AMONG LAMBDA BACTERIOPHAGES. Cordone, L.; Radman, M. (Univ., Palermo, Italy. Consiglio Nazionale delle Ricerche, Palermo, Italy. Univ. Libre, Brussels). Virology; 41: 166-9(May 1970).

Experimental results are reported, showing that one of the important factors in the UV-induced increase of recombination is the A-T content of the DNA regions involved. A model explaining the results is suggested and discussed. (auth)

31909 EFFECTS OF RADIATION ON CHROMOSOMES. Bender, Michael A. (Oak Ridge National Lab., Tenn.). An. Acad. Brasil. Cienc., 39: Suppl., 77-93(Dec. 31, 1967).

From Symposium on Peaceful Uses of Atomic Radiation, Rio de Janeiro, Brazil. See CONF-670709.

A review of radioinduced chromosomal aberrations in man is presented. The types of chromosomal aberrations, the kinetics and the fates are discussed. Studies on germ-line cells, somatic cells in vitro, and somatic cells in vivo are summarized briefly and aberration rates in populations and the possibilities of biological dosimetry are discussed. It is concluded that very little new information of basic significance has come from studies on human chromosome aberrations, but such work is of extreme practical importance. (C.O.)

31910 RADIATION AND THE HUMAN POPULATIONS. Stevenson, A. C. (Medical Research Council, Oxford). An. Acad. Brasil. Cienc., 39: Suppl., 95-113(Dec. 31, 1967).

From Symposium on Peaceful Uses of Atomic Radiation, Rio de Janeiro, Brazil. See CONF-670709.

The genetic effects of radiation on human populations is reviewed. Steps in estimating the frequency of mutation induction are discussed in the following contexts: complexities of dose mutation relations; applications of experimental evidence on dose mutation relations to man; simplifying assumptions; types of experimental evidence from mice that could be applied to man-gene mutations; population genetic structure and the fate

of induced mutations; chromosomal mutations; and hazards in perspective. Other sections are devoted to: the load of chromosomal aberrations in man and radiation hazards; mutation rates in man; and the estimate of the UN Scientific Committee on the Effects of Atomic Radiation for spontaneous total mutation rate on the X chromosome and by extension over the genome in man. (C.O.)

31911 GENETIC EFFECTS OF RADIATIONS. Pavan, C.; da Cunha, A. Brito (Univ., Sao Paulo, Brazil). An. Acad. Brasil. Cienc., 39: 115-28(Dec. 31, 1967). (In Spanish).

From Symposium on Peaceful Uses of Atomic Radiation, Rio de Janeiro, Brazil. See CONF-670709.

An introduction is given to the importance of the question of genetic effects of radiations. Experiments made on Drosophila willistoni, a neotropical species, were reported and compared with those made on species from the temperate zone. The analysis of the inverted chromosomes and their frequencies showed that this species is the most variable known. The results obtained can be summarized as the following: the frequency of chromosome II carriers of lethal or semilethal recessives varies in the population from 0.20 to 0.40; the mean individual frequency of lethal genes is of the order to 0.0006 to 0.0007; the rate of elimination of the lethal changes induced in high frequency was similar for the naturally induced changes and for the radiation-induced changes; the rate of elimination of the lethal mutations much greater than expected; this rate of elimination varies with the ambient mutations and with the total frequency of lethal mutations; and the rate of elimination of lethal mutations in the laboratory populations depends more on the degree of population variability than in more varied populations. A recommended bibliography for additional study in this area and a definition of terms used are included. (J.S.R.)

31912 USES OF GAMMA-FIELD IN PLANT BREEDING. Tatsuno, Tokuzo. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 682-90(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Uses of the γ field of the Institute of Radiation Breeding in Japan for the induction of mutations for the improvement of plants of agricultural importance are reviewed. The effects of daily and chronic exposure of plants on the mutation rate of barley, rice, and soybeans exposed at various growth stages were studied. The mutation rate following plant exposure was compared to that following seed exposure. Somatic mutations were induced by plant exposure in many fruit trees and tea plants, roses, and herbaceous plants such as chrysanthemum, potatoes, and sugarcane. Techniques were developed to enlarge the muted sector and to improve the efficiency of selection of mutants. Pollen of Lycospersicum peruvianum was exposed to chronic irradiation and crossed to produce many hybrids of tomatoes, including ones for male sterility. (C.H.)

31913 APPLICAZIONI DELL'ENERGIA NUCLEARE IN AGRICOLTURA. Atti del Simposio Nucleare Tenutosi a Palermo il 30 Maggio 1967. (Applications of Nuclear Energy in Agriculture. Nuclear Conference Held at Palermo, Italy, 30 May 1967). Serie Simposi. Roma; Comitato Nazionale Energia Nucleare (1968). 160p. (CONF-670558).

The nine papers presented at the Palermo Conference on the use of nuclear energy in agriculture were compiled. Individual abstracts were prepared for seven of the papers. (J.S.R.)

For abstracts of individual papers see: 31268, 31914–31917, 32314, and 32315.

31914 METHOD FOR THE GRADING OF VARIABLES INDUCED BY X RAYS IN WHEAT. Scossiroli, R. E. (Univ., Bologna). pp 27-39 of Applicazioni dell'Energia Nucleare in Agricoltura. Roma; Comitato Nazionale Energia Nucleare (1968). (In Italian).

From Applications of Nuclear Energy in Agriculture Conference, Palermo, Italy. See CONF-670558.

Wheat plants of the R_2 generation after the irradiation of seeds were graded according to plant height, the number of eared stalks the number of rows on the principal ear, and the number of seeds in the principal ear. The results are tabulated. All the characteristics seem to show a limited or no response to grading in the control group and a clear response in the irradiated group. Response to selectivity for plant height, number of rows on the principal ear, and the number of stalks with ears was studied and correlated for Triticum durum. The results were positive and showed that the use of ionizing radiation is an effective instrument for increasing the prospects of genetic improvement of cultivated plants. (J.S.R.)

31915 STUDIES IN EXPERIMENTAL MUTAGENESIS, THE GENETICS AND CYTOGENETICS OF TRITICUM DURUM. Bozzini, Alessandro (CNEN, Rome). pp 41-61 of Applicazioni dell'Energia Nucleare in Agricoltura. Roma; Comitato Nazionale Energia Nucleare (1968). (In Italian).

From Applications of Nuclear Energy in Agriculture Conference, Palermo, Italy. See CONF-670558.

A chronological review is presented of the more important studies on mutagenesis, genetics, and cytogenetics of Triticum durum. Effects of x rays, fast neutrons, and thermal neutrons, DES, and EMS on mutation frequencies are discussed. The genetic studies emphasized size, structure of stalk, resistance to mildew, resistance to P. recondita, dimensions of the fruit, morphology of the root, and precocity. (J.S.R.)

31916 MUTATIONS OF TRITICUM DURUM DESF. OBTAINED BY RADIATIONS PRODUCED IN A NUCLEAR REACTOR. Ballatore, Gian Pietro; Caruso, Pietro (Univ., Palermo, Italy). pp 63-81 of Applicazioni dell'Energia Nucleare in Agricoltura. Roma; Comitato Nazionale Energia Nucleare (1968). (In Italian).

From Applications of Nuclear Energy in Agriculture Conference, Palermo, Italy. See CONF-670558.

Results from the irradiation of seeds of Triticum durum Desf. exposed to thermal neutrons and α radiations are reported. The results obtained up to the R_4 generation are tabulated. The characteristics of the mutated wheat are compared with those of Capeiti 8, a variety widely grown in Sicily. (J.S.R.)

31917 STUDIES OF EXPERIMENTAL MUTAGENESIS IN PISUM SATIVUM. Monti, Luigi (CNEN, Rome). pp 83-100 of Applicazioni dell'Energia Nucleare in Agricoltura. Roma; Comitato Nazionale Energia Nucleare (1968). (In Italian).

From Applications of Nuclear Energy in Agriculture Conference, Palermo, Italy. See CONF-670558.

Results of studies made since 1962 on mutagenesis induced in peas by diethylsulfate or x rays applied to the seeds or the pollen are reported. The results obtained on the formation of chimeras and early section in M_1 with mutation frequency are discussed. The chlorophyll and morphological mutations and useful mutations obtained are described. (J.S.R.)

31918 EFFECT OF R FACTORS AND OTHER PLASMIDS ON ULTRAVIOLET SUSCEPTIBILITY AND HOST CELL REACTIVATION PROPERTY OF ESCHERICHIA COLI. Siccardi, A. G. (Stanford Univ., Calif.). J. Bacteriol.; 100: 337-46(Oct 1969).

Some R factors, like some colicin factors, confer partial protection against the bactericidal effect of ultraviolet (uv) irradiation. Of 31 plasmids (17 R, 3 col, and 11 R-col factors) tested in Escherichia coli K-12, 15 protected, 11 had little or no effect, and 5 caused increased uv susceptibility. The effect of representative plasmids was qualitatively the same in K-12 of wild-type uv sensitivity, λ-lysogenic or non-lysogenic, and in uv-sensitive mutants of classes uvrA, uvrB, uvrC, and recA (except that a sensitizing factor did not increase the sensitivity of two recA hosts). It is inferred that the uv-protecting effect of some plasmids does not result from their specifying enzymes similar to those deficient in such mutants. Ultraviolet killing of multiply auxotrophic K-12, of wild-type sensitivity or recA or uvrC, was reduced by deprivation of required amino acids for 2 hr before irradiation, and further reduced if starvation was continued for 2 hr after irradiation. The plasmids tested in these conditions produced qualitatively the same effects as in nonstarved cells—except that in K-12 of wild-type uv sensitivity the effect of protecting plasmids was reversed (i.e., they caused decreased survival) when the cells were starved after irradiation. Two uv-protecting R factors reduced the ability of HCR^+ K-12 to support growth of irradiated phage T1. (auth)

31919 ECCENTRICITY OF VERMILION DEFICIENCIES IN DROSOPHILA MELANOGASTER. Lefevre, G. Jr. (San Fernando Valley State Coll., Northridge, Calif.). Genetics; 63: 589-600(Nov 1969).

About 70% of all F_1 females that carry x-ray-induced mutations affecting the v locus are sterile; however, this is not true of EMS-induced v mutants. Among the relatively small group of fertile F_1 v mutant females produced after both 2000 and 4000 R exposures were those that possessed deficiencies of the v locus. Altogether, 18 x-ray-induced v deficiencies have been cytologically analyzed. Their right and left breakpoints are not symmetrically distributed around the v locus; rather, right breakpoints are found no farther than 5 or 6 bands to the right of the v locus (in 10A1), but left breakpoints occur as far as 48 bands to its left. The existence of a special locus between 10A1-2 and 10B1-2 that must be present in two doses in order for a female to achieve fertility may well be responsible for the apparent displacement of the right breakpoints to a position close to the v locus in the analyzed v defi-

ciencies. Deficiencies that include both v and the nearby fertility locus will be eliminated by sterility from the group of mutants available for analysis unless, by chance, the deleted segment becomes involved in an insertional translocation. In 4 such cases, the right breakpoints were farther to the right than were those in any of the 18 simple v deficiencies. The aneuploid deficiency segregants from 2 of the insertional translocations were sterile as heterozygous females; in the other 2, the deficiency heterozygotes were lethal. Quite a number of mutants having a chromosome break in 10A have now been found, but surprisingly few have a break elsewhere in Section 10. An analysis of male-lethal mutations known to be localized in Section 10 showed none to be cytologically deficient, although one was a reciprocal translocation. The scarcity of chromosomal aberrations affecting 10B-F probably reflects both a selection by sterility against deficiencies that involve material near 10B1-2 and a relatively low incidence of chromosome breakage resulting from the fact that this region is composed predominantly of faint, light-staining bands that in DNA content represent a much shorter length than their absolute number would suggest. Further, crossing over is low in the region between 10A1-2 and 10B1-2, represented in the salivary chromosome by extremely faint bands; it is high in the interval that includes 10A1-2, a prominent, dark-staining band. (auth)

31920 EFFECTS OF IONIZING RADIATION ON HUMAN CHROMOSOME. Marchionni, R.; Bersi, M.; Cardini, G.; Clemente, R. (Ospedali Riuniti, Verbania, Italy). Arch. Sci. Med.; 126: 165-81(1969). (In Italian).

The dangers to human chromosomes inherent in the indiscriminant use of ionizing radiations were discussed. The modality of action of cell irradiation was described, and the significance of lesions produced by ionizing radiation on genetic inheritance was discussed. The relation between irradiation and leukemia was suggested by reports that leukemia was observed 9 times as often in radiologists as compared to other physicians, increased leukemia in patients irradiated for ankylosing spondylitis, infants irradiated prenatally or for thymus hypertrophy, survivors of nuclear explosions in Japan, and persons residing in areas with high radioactivity levels. Effects of x-ray doses of from 25 to 400 R were studied in human lymphocyte chromosomes in vitro and in patients who were x irradiated in the lumbosacral area, and actions of radioprotective substances, such as bioflavanoids, DNA, cysteine, thioctic acid, glutamic acid, phenylalanine, tryptophan, methionine, and taurine on prevention of chromosome damage in bone marrow cells after exposure to x-ray doses of 400 R were discussed. The radioprotective agents that were most effective in preventing chromosome damage were cysteine and methionine, and the least effective agents were glutamic acid and taurine. (46 references.) (BBB)

31921 ACTION OF MUTAGENIC CHEMICALS ON ANACYSTIS NIDULANS. IV. ACRIDINE DYES. Kumar, H. D. (Univ. of Udaipur, India). Z. Allg. Mikrobiol.; 9: 137-42(1969).

A search for acridine-induced streptomycin-resistant and uv-resistant mutants of A. nidulans was made. Induced mutation frequencies were studied by growing the alga in culture media supplemented with acriflavine (1 μg/ml) or acridine orange (0.1 μg/ml) for 7 days under normal incubation conditions (26 to 27°C, 8000 to 9000 lux) followed by inoculating 0.2 ml (ca. 3 to 5×10^6 cells) or 0.5 ml aliquots from treated cultures on the surface of agar plates. Plates were incubated 7 days and then either overlaid with agar containing 10 or 50 μg streptomycin/ml or exposed to a uv-radiation source of 2537 Å at a distance of 25 cm for 15 min. After storing the uv-irradiated plates in the dark for 16 hr to avoid photoreactivation, they were incubated at 22°C for 10 days. During this period the sensitive background population was completely bleached or killed whereas the resistant mutants that survived the screening agent formed pin-point bright bluish-green colonies. The growth of this blue-green alga was inhibited by relatively low concentrations of acridine orange or acriflavine. No adaptation of growth concentrations higher than those tolerated by untreated organisms occurred during the course of 10 successive subcultures in media supplemented with these dyes. The frequencies of streptomycin-resistant and uv-resistant mutants were significantly greater in algal cells that had been repeatedly subcultured in acridine media. Cells grown on agar supplemented with acridine orange yielded many more streptomycin-resistant mutants than those grown on basal agar, thus confirming the mutagenicity of acridine orange in this alga. (BBB)

31922 GENETIC EFFECTS OF ^{32}P INCORPORATED INTO YEAST. Moustacchi, Ethel (Institut du Radium, Orsay, France). pp 17-27 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968). (In French).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

The effects of ^{32}P decay on lethality, mutagenicity and recombination were compared to effects of x-rays and uv light. 1. Lethal effect. Decay of ^{32}P incorporated in haploid yeasts causes a constant inactivation rate with a lethal efficiency $\alpha = 0.010$. Lethal efficiency of ^{32}P in diploid and tetraploid cells is low when decay begins (sigmoidal curves) and increases with progress of decay up to values comparable to the efficiency in haploid cells. The lethal effect of ^{32}P is not modified by phosphorus starvation which decreases the RNA content of the cells. The sensitive site to ^{32}P disintegrations might thus be DNA. It is shown that the lethal effect of ^{32}P decay is mostly due to transmutation. The relative proportion of dominant over recessive lethals induced in a diploid population is comparable to that of x-ray-induced lethal mutations (1/15). 2. Mutagenic effect. The spectrum and frequencies of genes reversions which are induced by ^{32}P disintegration are similar to those of x rays. The mutation frequency increases exponentially with ^{32}P decay for the cytoplasmic "petite colonie" mutation. The mutagenic efficiency of decay is therefore not constant. Two novel mutations were induced in yeast by ^{32}P decay: a mutation to radioresistance (xr) and a mutation expressed by an abnormal meiosis. 3. Effect on recombination. The frequency of mitotic recombination is enhanced by ^{32}P decay. The break and rejoining hypothesis in relation to this observation is discussed. (auth)

31923 LETHAL AND MUTAGENIC EFFECTS OF TRITIUM DECAY PRODUCED BY TRITIATED COMPOUNDS INCORPORATED INTO BACTERIA AND BACTERIOPHAGES. Person, S. (Pennsylvania State Univ., University Park). pp 29-64 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

The work discussed below is predominantly from the author's laboratory. Some effects of tritium decay on bacteria and bacteriophages, using labeled compounds that are incorporated preferentially into DNA, RNA or protein, have been studied. A relatively high killing efficiency, the probability that a single decay produces loss of colony-forming ability in bacteria or loss of plaque-forming ability in bacteriophages, is observed for thymidine-methyl-^{3}H decay, but this is thought to be due to β-particle ionization damage. The most definitive experiments involved a comparison of killing efficiencies for decays originating as thymidine-methyl-^{3}H in phage DNA and as amino acid-^{3}H in phage protein with the calculated β-particle path length through the DNA in the two cases. Experimental and calculated values are essentially the same. Radiation-dose calculations to many different bacterial sub-volumes were determined for several different distributions of radioactivity. The high killing efficiency for thymidine-methyl-^{3}H decay can be explained by β-particle ionizations, providing DNA is the sensitive target molecule and it is organized in a central volume of the cell. Although both the lethal and mutagenic effect of thymidine-methyl-^{3}H and amino acid-^{3}H decays can readily be explained on the basis of β-particle ionizations, the observed large mutation frequency produced by uracil-^{5}H decay cannot. The majority of mutations produced by uracil-^{5}H decays are due to a specific chemical rearrangement of the parent molecule, since decays from uracil-^{6}H are 6 to 7-fold less mutagenic. It is clear that the decays leading to mutations for cells labeled with uracil-^{5}H originate as cytosine-^{5}H in bacterial DNA. Recent work shows that the specific chemical rearrangement causes a C → T(u) genetic coding change. (auth)

31924 INDUCTION OF RECESSIVE LETHALS BY ^{3}H-URIDINE AND ^{3}H-THYMIDINE IN DROSOPHILA. Kleft, P. (Univ., Leiden. Inst. for Radiopathology and Radiation Protection, Leiden). pp 65-78 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

The mutagenic effects of tritium-labeled uridine and thymidine were studied in the male germ-cell stages of Drosophila melanogaster. Adult males were injected with the tritium-labeled nucleosides, and six successive two-day broods were scored for the induction of recessive lethal mutations. Maximum sensitivity to mutation induction was observed in the broods corresponding to spermatocytes and late spermatogonia. Changes in either specific activity (1.6 to 9.3 Ci/mM) or the total activity (250 to 1000 Ci/ml) of tritium in the labeled nucleosides did not result in significant changes of the rate of mutation induction. Uridine with

tritium in the 5 position of the pyrimidine ring produced approximately twice as many lethals as an equivalent dose of either 6-^{3}H-uridine or 6-^{3}H-thymidine. This observation is considered as an indication for a possible transmutation effect at the site of tritium decay. With 5-^{3}H-uridine the ratio of the frequencies of second chromosome lethals to sex-linked recessive lethals is 2 to 1 as might be expected when comparing the relative lengths of second and x chromosomes. With the other tritiated nucleosides used, the x and second chromosomes yielded identical lethal frequencies. Sex-linked recessive lethals are induced at a higher rate in the euchromatin than in the heterochromatin. Since in Drosophila only the x chromosome has a nucleolar organizer region, these findings make it unlikely that only nucleolar RNA is involved in the production of mutations by tritiated uridine. (auth)

31925 SOME ASPECTS OF TRANSMUTATION STUDIES IN DROSOPHILA. Oftedal, P.; Kaplan, W. D. (Norsk Hydro Inst. for Cancer Research, Oslo. City of Hope Medical Research Center, Duarte, Calif.). pp 79-90 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

The experimental data pertaining to the mutagenic efficiency of ^{32}P in Drosophila are discussed. It is estimated that the efficiency of the transmutation phenomena is of the order of 10^{-9} to 10^{-3} for the induction of recessive lethals. It is thus orders of magnitude lower than that found in bacteria and fungi. The efficiency would be lower—in comparison with the radiation effects—in organisms of greater dimensions than Drosophila, where a smaller fraction of dose is lost through the escape from the organism of high-energy β particles. Data are also reported on the genetic effects of ^{3}H-thymidine, ^{3}H-lysine and ^{3}H-arginine. It appears that in all probability the effects may be interpreted as caused by radiation alone, if due regard is given to variations in radiation sensitivity and cellular dimensions during spermiogenesis. (auth)

31926 CELLULAR REPAIR AFTER TRANSMUTATION INJURY. Drobnik, J. (Charles Univ., Prague). pp 109-17 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

There are in principle three direct ways of finding cellular repair of damaged DNA: using physico-chemical methods double- or single-strand scissions may be detected before and after the repair period. When some parts of the DNA are altered, specific excision may be expected, followed by liberation of the removed groups in the acid soluble fraction. Finally, dispersive replication of DNA occurs as a final step in DNA repair. Some other observations may serve as indirect evidence of recovery. Since the physiological conditions can hardly affect the primary lesions, the effect of various pre- and post-treatments is most likely to be interpreted in terms of cellular repair. The most common way in which the biological injury is presented—the killing curves—provides an excellent source of information on the recovery activity of organisms, particularly when various mutants are compared. Using some of these possible patterns of analysis, we may conclude that cellular repair does operate on the lesions caused by transmutations in DNA macromolecules. (auth)

31927 USE OF CHRONIC IRRADIATION IN MUTATION BREEDING. Report of Symposium Held on July 27-28, 1967, Ibaraki, Japan. Gamma Field Symposia. Number 6. Ibaraki, Japan; Institute of Radiation Breeding, Ministry of Agriculture and Forestry (1967). 136p. (In Japanese and English). (CONF-670739).

Construction of a gamma field with a 100 m radius was completed in 1961 in Japan. Since 1962 the field has been used by geneticists and plant breeders. Collaborative research has been supported by the Ministry of Education. Data obtained from radiation experiments on a number of plants were presented and discussed. Separate abstracts have been prepared for all six of the papers included in this report. (M.M.B.)

For abstracts of individual papers see: 31928–31932 and 32003.

31928 RADIOSENSITIVITY AND INDUCTION OF SOMATIC MUTATIONS IN WOODY PERENNIALS UNDER CHRONIC GAMMA RAY IRRADIATION. Nishida, T.; Nakajima, K.; Ohba, K.; Takato, S. (Inst. of Radiation Breeding, Ibaraki, Japan). Gamma Field Symp.; No. 6, 19-45(1967).

From Symposium on Use of Chronic Irradiation in Mutation Breeding, Ibaraki, Japan. See CONF-670739.

The results of studies on the induction of somatic mutations and the radiosensitivity of woody perennials under chronic gamma irradiation from 1962 to 1966 are reported. Various strains and varieties of a number of species were planted at distances from 10 to 100 meters from a source of 2000 Ci of cobalt-60 and irradiated 20 hr per day except Sundays and holidays. Other plants were placed within the gamma field in pots for periods less than 12 months. Radioinduced injuries to individual organs, alterations in phenotypical characters and growth patterns, lethal exposure rates, and radioinduced somatic mutations are described. (M.M.B.)

31929 DIFFERENTIAL SENSITIVITIES OF RICE PLANT AT EARLY GROWTH STAGES TO ACUTE AND CHRONIC GAMMA-RAY. Niwa, Masaru; El-Keredy, Mohamed S. (Tokyo Univ.). Gamma Field Symp.; No. 6, 47-69(1967).

From Symposium on Use of Chronic Irradiation in Mutation Breeding, Ibaraki, Japan. See CONF-670739.

Rice plants (variety Kinmaze) were irradiated by ^{60}Co gamma-ray with different durations ranging from 1 to 16 days during 3 growth stages, i.e. dormant seed, germinating seed (3 to 21-day-old plants) and seedling (25 to 43-day-old plants), in order to compare the effects of different treatments on M_1 plant growth, seed fertility of M_1 plants and induction of chlorophyll mutations. Total exposure dosage seemed to be an only factor deciding seedling height after irradiation of dormant seed. Neither dose rate nor length of storage period after irradiation affected seedling growth. Inhibiting effect of radiation on plant growth increased with increasing plant age up to 12-day-old. Fractionation of irradiation did not reduce the inhibiting effect in germinating seed stage, indicating that plant age at the time of irradiation is more important to plant growth than dose rate in this stage. On the other hand, fractionated irradiations resulted in less growth retardation than acute ones in seedling stage. Seed sterility was increased with the increase of total exposure dosage to dormant seed. But no definite tendencies in the change of sterility were observed with dose rate and length of storage period after irradiation. Radiosensitivity exhibited as seed sterility increased after soaking of seed until plants grew to 25-day-old. Chronic irradiations of germinating seed and seedling resulted in lower seed sterility than acute. The dose rate effect was more clearly observed in seedling stage than in germinating seed stage. Number of initial cells of an M_1 panicle at the time of irradiation was estimated on an assumption that the ratio of sterile seed in a panicle was binomially distributed among M_1 panicles. The estimated number of initial cells presented high negative correlation with seed sterility. No appreciable change was observed in initial cell number if compared among different growth stages and/or plant ages at the time of irradiation. Frequency of M_1 panicle line, where chlorophyll mutants were segregated, increased with increasing exposure dosage to dormant seed. Neither storage effect nor dose rate effect was observed in this frequency. This was considered to be due to relatively high moisture content in the dormant seed used in the present experiment. Frequency of mutated panicle line increased with increasing exposure dosage to growing plants and plant age. Treatment of 21-day-old seedling resulted in the highest frequency among all. Fractionated (chronic) irradiation in seedling stage brought higher frequency of mutated panicle line than acute ones. Segregation ratio of mutants in an M_1 panicle line revealed a reasonable relationship to the estimated number of initial cells of an M_1 panicle estimated from seed sterility ratio. Chlorophyll mutation rate in an initial cell was estimated by means of a proposed model in this report. Rather quadratic relationship was seen between exposure dosage and the estimated mutation rate. Chronic irradiation in seedling stage resulted in lower mutation rate than acute one. Higher frequency of mutated panicle line by chronic irradiation in seedling stage was considered to be due to larger number of survived initial cells. Relationship among growth inhibition, seed sterility and mutation rate suggested that higher mutation rate with less harmful effects would be gained by chronic irradiation of growing rice plants than acute irradiation and irradiation of dormant seed. (auth)

31930 EFFECTS OF ACUTE AND CHRONIC GAMMA-RAY IRRADIATIONS ON GROWING BARLEY PLANTS. Yamashita, A. (Inst. of Radiation Breeding, Ibaraki, Japan). Gamma Field Symp.; No. 6, 71-95(1967).

From Symposium on Use of Chronic Irradiation in Mutation Breeding, Ibaraki, Japan. See CONF-670739.

Barley plants were exposed to cobalt-60 γ irradiation either for the whole growing period, for different vegetative stages (chronic or acute irradiation), for vegetative stages of different duration in addition to the reproductive stage (chronic), for five different reproductive stages from differentiation of pollen mother cells to heading (acute), of pollen and egg at heading (acute), at the embryo development stage from fertilization to maturity (acute and chronic), or of dormant seeds (acute). Acute irradiation lasted

one or two days at 200 to 3000 R/day while chronic irradiation lasted for 15 days or more. The effects of these treatments on spike fertility, size of mutated spike sector, and rate of mutations affecting chlorophyll are described. These effects are compared with the effects of chronic and acute irradiation in other species of plants. In contrast to rice, chronic irradiation of growing barley plants does not seem to be better for mutation induction than seed irradiation. (M.M.B.)

31931 STUDIES ON RECURRENT IRRADIATION OF RICE PLANTS IN THEIR SUCCESSIVE GENERATIONS. Tanaka, Sachihiko (Inst. of Radiation Breeding, Ibaraki, Japan). Gamma Field Symp.; No. 6, 97-106(1967).

From Symposium on Use of Chronic Irradiation in Mutation Breeding, Ibaraki, Japan. See CONF-670739.

In an effort to obtain high mutation rates in rice populations low exposure rates were applied to successive generations of plants. A diploid line derived from a haploid Norin #8 was used. In each of nine levels of exposure in the cobalt-60 gamma field, 80 plants were exposed to recurrent chronic irradiation. Every year four seeds were randomly selected from each plant and 80 seedlings were grown at each level. The exposure rates were 0, 5, 10, 20, 40, 80, 150, 200, and 250 R per 20-hr-day for 100 to 107 days per yr for 6 yr from 1962 to 1967. The plants were scored for mutations affecting chlorophyll, fertility, and morphology. Radiation damage was less and mutation rates were higher after these treatments than after acute irradiation of dormant rice seeds. The annual mutation rate was nearly constant and a saturation effect was noted at the higher exposure rates. There were complicated phenotypes observed, but new types of mutations were very rare. Most of the treated lines produced some mutations. (M.M.B.)

31932 STUDIES OF RADIATION BREEDING IN THE TEA PLANTS. Futsuhara, Yuzo (Nagoya Univ., Japan). Gamma Field Symp.; No. 6, 107-22(1967).

From Symposium on Use of Chronic Irradiation in Mutation Breeding, Ibaraki, Japan. See CONF-670739.

The effects of γ and x irradiation on various varieties of Thea sinensis were investigated. Buds or plants were x-irradiated with doses ranging from 3 to 30 kR. Plants were also grown in a gamma field at various distances from the cobalt-60 source receiving total doses ranging from 5 to 20 kR. The histological abnormalities in buds induced by chronic γ irradiation were similar to those in buds receiving acute x irradiation but their frequency was lower. Different varieties of tea plants differed in their radiosensitivity as measured by defoliation and necrotic spots on leaves. Radio-induced abnormalities included deformation in size and shape of leaves, fasciated stems, forked petioles, and chlorophyll deficiency. The results of various methods of cutting back shoots indicated that pruning should be done as low as possible on shoots in order to sprout the secondary buds from the originally irradiated tissue which is most likely to contain mutated cells. (M.M.B.)

31933 MOLECULAR GENETICS. 4th Scientific Conference of the German Society for Natural Sciences and Medicine, Berlin, 1967. Wittmann, H. G.; Schuster, H. (eds.). Berlin, Springer-Verlag, 1968. 349p. $12.00; DM 48,-. (CONF-671085).

Papers presented at the conference reported research on structure and function of ribosomes and complementation, codons and protein synthesis, alteration of DNA (modification, reactivation, and mutation), cell regulation, and replication and function of viruses. Among the 30 papers separate abstracts were prepared for four. (M.M.B.)

For abstracts of individual papers see: 31934–31937.

31934 GENETIC RECOMBINATION INDUCED BY ULTRAVIOLET LIGHT. Howard-Flanders, Paul; Wilkins, Brian M.; Rupp, W. Dean (Yale Univ., New Haven). pp 161-73 of Molecular Genetics. Wittmann, H. G.; Schuster, H. (eds.). Berlin, Srpinger-Verlag, 1968.

From Symposium on Molecular Genetics, Berlin, Germany. See CONF-671085.

When DNA containing uv-induced pyrimidine dimers is replicated, the newly synthesized strands appear to be discontinuous. The spacing between these discontinuities is approximately equal to that between the pyrimidine dimers. The discontinuities were detected in experiments on DNA replication in Escherichia coli K12, both during vegetative growth and during DNA transfer between conjugating cells. When excision-defective Hfr or F^+ donors were lethally uv-irradiated and crossed with F^- bacteria, the chromosomes or episomes were transferred almost normally. Recombinants were formed at 5 to 30% of the normal yield, and contained multiple short lengths of transferred DNA. The genetic activity of DNA transferred from a uv-irradiated donor was identical in normal and excision-defective recipients. Since an intact complementary strand is needed for repair by excision, this failure to detect repair in the recipient suggests that the complementary strand may be discontinuous opposite each pyrimidine dimer. Thus, recombination tends to occur following replication, and may be initiated by stabilized internal free ends so formed. (BBB)

31935 REPAIR OF DNA IN A MUTANT OF E. COLI TEMPERATURE-SENSITIVE IN DNA SYNTHESIS. Seehafer, J.; Schuster, H. (Max-Planck-Institut fuer Molekulare Genetik, Berlin). pp 174-9 of Molecular Genetics. Wittmann, H. G.; Schuster, H. (eds.). Berlin, Springer-Verlag, 1968.

From Symposium on Molecular Genetics, Berlin, Germany. See CONF-671085.

Experiments to study the kinetics of repair of uv-irradiated phage DNA were done in cells of E. coli K12 T^s_{DNA}. The results indicated that after a period of incubation under conditions where DNA synthesis was prevented, caffeine no longer affected host cell reactivation (HCR). Similar results were obtained with uv-irradiated phage T1 using the E. coli mutant B94 (ad^-, arg^-) in which DNA and RNA synthesis can be blocked by adenine withdrawal. The kinetics of recovery of colony-forming ability of the irradiated T^s_{DNA} mutant were followed in a similar manner to that described for survival of phage λ. Dark reactivation (DR) of lethal hits became insensitive to acriflavine during the time of exposure to 41°C, similar to the HCR of uv damage in phage DNA. The repair mechanism of the mutant active at 41°C does not discriminate between phage DNA and its own DNA. Similar results were obtained with the E. coli mutant B94 in the absence of DNA synthesis although in this case the time for DR was much longer (4 to 5 hr). One-step growth curves were examined for irradiated and unirradiated phage λ in the T^s_{DNA} mutant at 33°C with and without preincubation at 41°C. Phages were irradiated to yield a survival of 1 to 3×10^{-3}. The eclipse period of unirradiated phages at 33°C with and without 35 min preincubation at 41°C was the same. With irradiated phages and without preincubation a growth delay of 32 min was observed. On the other hand 41°C pretreatment shortened the growth delay period to only 12 min. These results indicated that growth delay was caused, at least partially, by HCR mechanisms. (BBB)

31936 PROPHAGE ATTACHMENT AND DETACHMENT: COMPARISON OF PHAGES P2 AND λ. Bertani, G. (Karolinska Institutet, Stockholm). pp 180-6 of Molecular Genetics. Wittmann, H. G.; Schuster, H. (eds.). Berlin, Springer-Verlag, 1968.

From Symposium on Molecular Genetics, Berlin, Germany. See CONF-671085.

A review of recent work on the temperate Escherichia coli bacteriophage P2 is presented with emphasis on comparisons to phage λ. Among the results reported is a description of temperature-dependent mutants of P2. E. coli strains lysogenic for these mutants fail to produce appreciable phage at 42°C unless superinfected with wild type P2. This treatment is most effective when the superinfecting phage has been 50% inactivated by uv irradiation. (M.M.B.)

31937 MUTANTS OF SERRATIA MARCESCENS DEFECTIVE OR SUPERACTIVE IN THE RELEASE OF A NUCLEASE. Winkler, U. (Goethe-Univ., Frankfurt am Main). pp 187-201 of Molecular Genetics. Wittmann, H. G.; Schuster, H. (eds.). Berlin, Springer-Verlag, 1968.

From Symposium on Molecular Genetics, Berlin, Germany.

A strain of Serratia marcescens termed W200 is somewhat deficient in its ability to photoreactivate uv-radioinduced injuries, but still retains, although reduced, the wild type's (HY) ability to reactivate uv-radioinduced damage in the dark. S. marcescens W200 was found to produce extracellular nuclease active against both DNA and RNA. Mutants were isolated which were either defective or superactive in their production of extracellular nuclease. Neither type of mutant differed from the parent strain in its ability to reactivate in the dark lethal uv-radioinduced damage in the bacteriophage Kappa. Other characteristics of these mutants are presented. (M.M.B.)

31938 STUDIES ON THE APPLICATION OF CELLULASES AND HEMICELLULASES IN FARM PRODUCTS PROCESSING. I. Cho, Han Ok; Lee, Heung Shik; Kim, Hee Chang (Radiation Research Inst. in Agriculture, Seoul). J. Nucl. Sci. (Seoul); 9: No. 1, Pt. 2, 49-58(Jul 1969). (In Korean).

The strains excreting cellulase and hemicellulase were separated from the soil, chicken feces, and decayed wood. According to the strains, C.M.C.-liquefying activity and decomposing activity of cellulose powder, xylan, rice bran, chaff, hay, corn, wheat, naked barley, rice straw, and mixed feed were measured by Wakazawa and Toyama Methods, respectively. Some of the selected strains were irradiated by γ-ray for the purpose of encouragement of mutant. The results can be summarized as follows. Strong cellulase and hemicellulase excreting strains, such as N-1(Aspergillus niger: unidentified), N-3(Asp. niger) and

N-TV(Trichoderma viride: unidentified) were separated from the soil, chicken feces, and decayed wood. N-1, N-3, and N-TV were similar in the C.M.C.-liquefying activity and the decomposing activity was proportional to the concentration of enzymes. The optimum pH ranges of N-1, N-3, and N-TV were from 3 to 4 and temperature 40 to 50°C. Cellulose powder decomposing activity of N-TV was 41% and N-1, N-3 about 17%. Concerning the decomposing activity of xylan which was prepared from the rice straw, N-1 and N-3 were 64 to 65%, and N-TV 45%. In the liquefaction and saccharification of rice straw, chaff, and hay, activity of combined enzyme (N-1 and N-TV) was increased 2 to 4 times compared with that of the individual enzyme. Those enzymes can be used for the purpose of farm product processing and for development of feeds. Encouragement of mutants by γ irradiation was not so good. (auth)

31939 IRRADIATION OF THE LUMBOSACRAL SPINE: PERSISTENCE OF CHROMOSOME DAMAGE. Cardini, G.; Galimberti, A.; Riggio, G. (Ospedali Riuniti, Verbania, Italy). Arch. Ortop.; 79: 367-70(1966). (In Italian).

The persistence of chromosome damage in peripheral blood of 6 adult patients x irradiated for lumbosacral arthroses, from 3 months to 11 yr previously, with doses that ranged from 800 to 1500 R was discussed. In the mitoses observed in cultured blood lymphocytes there was evidence of chromosomal damage consisting of fragmentation, dicentrics, junctions and polyploidy. The numbers of mitoses examined in each patient ranged from 62 to 102. Polyploidy, fragmentation, and dicentrism was observed predominantly in patients who had been most recently irradiated, while junctions were seen most frequently in the patients who had been irradiated from 6 to 11 yr previously. However, all of the patients observed showed some evidence of each of the types of chromosome damage found. The patient last irradiated only 3 months previously showed 53% mitotic alterations, while in the patient who had been irradiated 11 yr previously 21% of the mitoses observed showed chromosomal damage. (BBB)

31940 GERMINATION STAGE IN RICE SEED THAT PRODUCES THE GREATEST YIELD OF RADIATION-INDUCED MUTATIONS. Yamaguchi, Hikoyuki (Tokyo Univ.). Mutat. Res.; 8: 655-7(Nov-Dec 1969).

Dry seeds of rice (Oryza sativa cultivar Kinmaze) were soaked in water for 54, 56, 58, 60, 62, and 64 hr at 25°. The seeds were then removed and irradiated with 10,000 R of ^{137}Cs γ rays. Criteria used to measure the radiosensitivity were survival rate at maturity of the X_1 plant, missing seed setting (sterility) in X_1 panicles, and frequency of chlorophyll mutations in the X_2 generation. There was a gradual decrease in the survivals up to 58-hr soaking at which time it reached a minimum of 32.9% and then increased. The highest incidence of radioinduced sterility was in irradiation of 58-hr soaked seed. The mutation frequency in 58-hr soaked seed was very high. It then suddenly fell at 60-hr soaking and then gradually increased with increasing soaking times. Irradiation of 60-hr seed produced little if any mutation. The possible explanations for this are discussed. It is concluded that the clear peak in lethality or sterility and chlorophyll mutation observed at 58-hr soaking is caused during the first round of DNA replication in the embryo cells of germinating seed. (C.O.)

31941 X-RAY MUTAGENESIS IN THE SILKWORM WITH SPECIAL REFERENCE TO THE INDUCTION OF WHOLE-BODY AND MOSAIC MUTATIONS. Inagaki, Eiichi; Nakao, Yoshio (National Inst. of Radiological Sciences, Chiba, Japan. Hiroshima Univ.). Mutat. Res.; 9: 109-16(Jan 1970).

A comparative study of the frequency patterns of whole-body and mosaic mutations induced by x rays in mature sperm and mature oocytes of the silkworm was made. It was found that x-irradiation of mature sperm of the silkworm induced a high frequency of mosaic mutations in addition to whole-body mutations at the two marker loci, pe and re. The frequency of whole-body mutations increased linearly with dose, while that of mosaics increased with a dose-exponent greater than I. These findings are in good agreement with the earlier observations by Tazima. However, the picture of the latter type of mutations is in sharp contrast to that observed in Drosophila sperm where the yield of mosaic mutations reaches a constant maximum level at a fairly low dose level. Since it was found that about half of the recovered mosaics after x-irradiation of silkworm sperm were characterized by small patches, it appeared that many of the mutations expressed as mosaics might be associated with an unstable condition at localized regions which not only can produce mutations but also replicate as instabilities through many cell cycles. Conceivably, such chromosome changes would be associated with multiple breakage events usually produced by two or more hits. In contrast to the results obtained in mature sperm, x-irradiation of mature oocytes produced predominantly whole-body mutations. The frequency of whole-body mutations increased rapidly with a higher power of dose than I but that of mosaics increased only slightly. It is suggested that the sharp increase of whole-body mutations might be due to the fixation of the unstable chromosome changes to stable mutations expressed as whole-body during the meiotic divisions. At the present state of our knowledge, the nature of such instabilities is a matter for speculation. (auth)

31942 ON THE NATURE OF Y CHROMOSOME FRAGMENTS INDUCED IN DROSOPHILA MELANOGASTER FEMALES. II. MATURE OOCYTES. Williamson, John H. (Univ. of California, Riverside). Mutat. Res.; 9: 85-90(Jan 1970).

The induction of fragments of Y chromosomes in Drosophila melanogaster females carrying a compound-X and a Y chromosome depends on association of the Y with some other chromosome or association of the 2 arms of the Y. About 75% of all Y chromosome fragments recovered from irradiated immature oocytes are products of induced interchange between the Y and the 4th chromosome or between the 2 arms of the Y. In contrast, only about 50% of all fragments recovered from mature oocytes could be identified as to the type of interchanges producing Y fragments. Very few of these were Y-4 interchanges while some 20-25% were estimated to be Y-major autosome interchanges. The suggestion has been made that in immature oocytes all chromosomes are associated in a chromocentral-like arrangement that may correspond to the karyosome of the developing oocyte, but that in the mature oocyte homologs and heterologs have effectively moved apart. (auth)

31943 STUDY OF MITOTIC CONVERSIONS AT THE LEVEL OF ad-9 GENE IN SCHIZOSACCHAROMYCES POMBE. Adondi, G.; Heslot, H. (Institut National Agronomique, Paris). Mutat. Res.; 9: 41-58(Jan 1970). (In French).

Mutants ad-9 of Schizosaccharomyces pombe are characterized by a double requirement for adenine and histidine. The heteroallelic diploids synthesised have shown no complementation. These diploids are subject to mitotic recombinations, whose frequency can be increased by x rays and uv light. The recombinations are in fact conversions, which have been analyzed by haploidisation of prototrophic diploids under the effect of m-fluorophenylalanine. We have detected no polarity. Contrary to what occurs at the ad-3 locus of Saccharomyces cerevisiae, L-histidine has no effect on the frequency of mitotic recombination. Quantitative data concerning the frequency of mitotic conversion as a function of x rays or uv light dose enabled us to construct a map of sites at the ad-9 locus. The order found is the same as that deduced from meiotic recombination. (auth)

31944 FORMATION OF CHROMOSOMAL ABERRATIONS. Heddle, John A.; Bodycote, D. Judy (Univ. of California, San Francisco). Mutat. Res.; 9: 117-26(Jan 1970).

The exchange hypothesis and the breakage-first hypothesis are the 2 major hypotheses that describe how chromosomal aberrations might be produced. A critical test has shown that one important aspect of the exchange hypothesis is correct, namely that some aberrations that appear to be simple chromatid deletions are actually incomplete exchanges. Furthermore, the relative frequency of those deletions that could be positively identified as incomplete exchanges was very close to that predicted from the exchange hypothesis. Because the sample was small and because a mixture of 2 deletion types (true, non-exchange deletions and incomplete exchanges between sister chromatids) could have given the same results, further experiments were performed. The results show that chromatid deletions are indeed of 2 types, since the relative proportion of exchange deletions is not the same in Chinese hamster cells as in rat kangaroo cells, nor is it the same in S and in G_2 of Chinese hamster cells. Thus, some chromatid deletions are simple deletions arising from single lesions as expected on the basis of the breakage-first hypothesis and others are incomplete exchanges between sister chromatids as expected on the exchange hypothesis. It is clear, then, that neither hypothesis, as usually interpreted, is entirely correct nor incorrect, but rather that deletions are of 2 types according to mode of origin. Attempts to identify the 2 types morphologically have failed. The data also suggest that some of the chromosomal changes that we and others have considered to be gaps are actually true deletions. This is important because many of the changes produced by chemicals in cultured mammalian cells are of this type. (auth)

31945 SPECIFICITY FOR SPONTANEOUS AND INDUCED FORWARD MUTATION AT SEVERAL GENE LOCI IN ASPERGILLUS NIDULANS. Alderson, T.; Hartley, M. J. (Cambridge Univ., Eng.). Mutat. Res., 8: 255-64(Sept.-Oct. 1969).

A newly-devised mutational system in Aspergillus was used to

provide a comparison of the response of at least eight gene loci to spontaneous and induced forward mutation by various mutagens, namely, N-methyl-N-nitroso-N'-nitroguanidine, nitrous acid, diethyl sulfate, diepoxybutane, 2-methyl-6-chloro-9-[3-(ethyl-2-chloroethyl)aminopropylamino]acridine dihydrochloride, γ irradiation, and uv irradiation. The results clearly show differences in the distribution of mutations induced at these gene loci by the different mutagens. Data are also presented where the same type of mutants, induced by various means, were examined for their ability to revert to a wild-type condition, and for their simultaneous association with a translocation. Induced specificity is briefly discussed in relation to direct effects of the mutagens on DNA bases; effects of mutagens on later stages of the mutation process; and mechanistic effects leading to variations in the proportion of simple (revertible) to the more complex (non-revertible) molecular changes induced. (auth)

31946 ULTRAVIOLET-INDUCED MUTATION AND DNA REPAIR. Witkin, Evelyn M. (State Univ. of New York, Brooklyn). Annu. Rev. Microbiol.; 23: 487-514(1969).

The mechanisms by which uv radiation induces mutations and by which DNA molecules are repaired are reviewed. Dimers of adjacent pyrimidine bases in the same DNA chain may be formed as a result of uv irradiation. Thymine-thymine dimers are formed more readily than cytosine-thymine or cytosine-cytosine dimers. Although pyrimidine dimers are not the only photoproducts formed in bacterial DNA by uv light, they cause most of the lethal and mutagenic effects observed in some strains of bacteria at low doses. The 3 repair mechanisms in Escherichia coli that promote survival after exposure to uv irradiation are reviewed. The pyrimidine dimers repaired by photoreactivation or by excision repair are much less likely to cause mutations than unrepaired pyrimidine dimers in DNA. Unrepaired pyrimidine dimers (and possibly other unrepaired uv photoproducts) cause mutations by inducing the formation of daughter strand gaps, one gap opposite each unrepaired lesion. These gaps, which are lethal if not repaired, cannot be mended by repair replication because each is located opposite a noncoding lesion. They are repairable only by a mechanism which probably involves some form of genetic recombination between complementary daughter strands, one of which is always intact in a region where the other has a gap. Most uv-induced mutations are errors introduced into the DNA during inaccurate recombinational repair of single-strand gaps. (BBB)

31947 PRESENCE OF AN ADDITIONAL METACENTRIC CHROMOSOME IN AKR/TIALD LEUKAEMIC CELLS. Legrand, E.; Duplan, J. F. (Laboratoire Pasteur, Paris). Nature (London); 225: 737-8(21 Feb 1970).

There is accumulating evidence that cells with a chromosomal imbalance are very sensitive to chemical and physical agents that induce chromosomal abnormalities, and some irradiation studies are described with mice of the AKR substrain of T1ALD, which has only 38 chromosomes. It was found that an additional metacentric chromosome frequently occurred in both spontaneous and radiation-induced leukaemic cells and a description is given of the various patterns in the chromosome alterations. Irradiation was with x rays at about 100 R/min. The mice were exposed either to an acute whole-body irradiation of 900 R or to four weekly exposures of 175 R. Radiation seems responsible for some structural changes in the metacentric chromosomes, although playing a negligible part in their production. (UK)

31948 PERSISTENCE OF CHROMOSOME REARRANGEMENTS INDUCED IN MALE MICE BY X-IRRADIATION OF PRE-MEIOTIC GERM CELLS. Leonard, A.; Deknudt, Gh. (Dept. of Radiobiology, Mol, Belg.). Mutat. Res.; 9: 127-33(Jan 1970).

Male $C_{57}BL$ mice received local irradiation to the testes with an exposure of 600 R of x rays. The irradiated mice were killed 60-600 days after treatment, the testes were removed and meiotic preparations made by an air-drying method. Most of the cells showed 20 bivalents (20II), but multivalent configurations were recorded in the spermatocytes from irradiated animals and from old control males. In the irradiated males, the percentage of spermatocytes with chromosome rearrangements increased from 8.4 after 60 days to 12.6 after 100 days. The yield of abnormal cells remained at that level from 100 days to 200 days and then decreased up to 450 days after irradiation. A small increase occurred after 500 and 600 days. (auth)

31949 EFFECTS OF MUTATIONS TOWARDS ULTRAVIOLET SENSITIVITY IN YEAST. Zakharov, I. A.; Kozina, T. N.; Fedorova, I. V. (Ioffe Inst. of Physics and Tech., Leningrad). Mutat. Res.; 9: 31-9(Jan 1970). (In French).

UV-sensitive mutants were induced by the action of uv light and were isolated by the replica plating method. Highly homozygous stocks of yeast Saccharomyces cerevisiae descending from race XII were utilized as material for the present investigation. Two mutants, designated uvs_1 and uvs_2, carrying non-allelic mutations of radiosensitivity, were studied more carefully. UV sensitivity appeared to be of a recessive monogenic character; heterozygous diploids were uv-resistant and segregated 1:1 resistant and sensitive clones in the random ascospore samples. The uv sensitivity of the strains bearing mutants uvs_1 and uvs_2 differs. The haploid uvs_1 mutant and the haploid uvs_2 mutant have sensitivities 25 and 1.8 times higher, respectively, than the wild-type haploid. The uvs_1 mutants exhibit an exponential survival curve, while the uvs_2 mutants and the wild-type haploid have sigmoidal shaped curves. The radioresistance of the isogenic strains, carrying the mutations at the uvs_1 locus, increases with polyploidy. The effect of uvs mutations on the frequency of induced genic mutations could be studied due to the fact that the resistant mutants could easily be detected in the media with a high serine concentration. The results indicate that the uvs_1 and uvs_2 mutations significantly increase the sensitivity of haploids to mutagenic action of uv light. The uvs_1 and uvs_2 mutations also result in an increase in sensitivity to mutagenic action of uv light in regard to cytoplasmic determinants. The diploids homozygous for uvs_1 and uvs_2 mutations proved to be highly sensitive to the action of uv light causing recombination when the frequency of induced mitotic recombination in resistant and sensitive diploids heterozygous for ad_1 and ad_2 genes was recorded. The frequency of spontaneous mutations independent of adenine was recorded in haploids of genotype ad_2, ad_2 uvs_1 and ad_2 uvs_2. The mutations towards uv sensitivity cause a sharp increase in spontaneous mutability, the rise being especially significant due to uvs_2 mutations. The specific features of uvs_2 mutants of Saccharomyces are similar to those of uv-sensitive mutants of E. coli; therefore, one might suggest that the uvs mutants in yeast also have a less efficient or blocked system for repair of uv damage in the DNA. The fact that the uv-sensitive mutants are sensitive not only to the lethal action of uv light but also to the mutagenic and recombinogenic ones suggests that similar molecular damages of the DNA underlie all these effects. The induction of cytoplasmic mutations in uv-sensitive mutants suggests that the repair system under consideration is localized not only in the nucleus but also in the cytoplasm of the cell. The sharp increase in spontaneous mutability in uv-sensitive mutants indicates that the main function of the repair system is to maintain the stability of genetic material under natural conditions. (auth)

31950 CYTOGENETIC RADIOSENSITIVITY AND CHIASMA FREQUENCY IN WILD-LIVING MALE MICE. Searle, A. G.; Berry, R. J.; Beechey, C. V. (Medical Research Council, Harwell, Eng. Royal Free Hospital Medical School, London). Mutat. Res.; 9: 137-40(Jan 1970).

Male house mice from an island in Wales were exposed to 300 R whole-body x radiation. Fifteen weeks later the mice were killed and cytological preparations of the testes were made. There was a 2% frequency of multivalent configurations in these, while the controls showed only a 0.2% frequency. Laboratory strains of x-irradiated mice show a frequency three to four times higher than the irradiated wild mice; the control frequencies in wild and laboratory mice are similar. It was found that the frequency of chiasmata per autosomal chromosome in spermatocytes was significantly lower in wild mice than in laboratory mice. It is suggested that there is a relationship between the lowered radiosensitivity of the wild mice and the very low chiasma frequency. (H.L.W.)

31951 RADIOSENSITIZING EFFECT OF EXTRACT FROM GERMINATING BARLEY SEEDS. Sharma, B. (Indian Agricultural Research Inst., New Delhi). Int. J. Radiat. Biol.; 17: 15-18(1970).

Filterable extract was obtained from germinating seeds of barley, variety N.P. 104. Seeds of the same variety were soaked for 5 hours in equal quantities of this extract and distilled water. The two types of pre-soaked seeds, along with a set of dry seeds, were irradiated with increasing doses of gamma-rays from 10 kR onward. The pre-soaked seeds produced a higher mutation rate than dry seeds; but soaking in water resulted in less radiosensitization than soaking in the extract. The difference between mutation frequencies was smallest at the lowest dose of radiation and constantly increased with the application of higher doses. The seed extract may affect certain processes that are little or not at all affected by water alone. The greater effectiveness of seed extract is better seen at higher doses of radiation; at lower doses the total damage is too small to give a significantly different response to the two forms of soaking. (auth) (UK)

31952 PROLIFERATIVE ACTIVITY OF THE BONE MARROW OF DOGS EXPOSED TO CHRONIC GAMMA-IRRADIATION. Zukhbaya, T. M. Kosm. Biol. Med.; 3: No. 6, 32-5(Nov-Dec 1969). (In Russian)

The mitotic activity and chromosome aberrations in the bone marrow of dogs exposed to a chronic gamma-irradiation at doses of 25, 75, and 150 r per year were studied. No noticeable changes in the proliferative activity were found. An increase of chromosome aberrations was seen in the animals irradiated with doses of 75 and 150 R/year. (auth)

31953 INTERNATIONAL SYMPOSIUM ON GENETIC EFFECTS ON SPACE ENVIRONMENT. Symposium Held at Tokyo, August 25, 1968. Jap. J. Genet.; 43: 457-78(Dec 1968). (CONF-680844-(Absts.)).

Abstracts of 12 papers plus the opening remarks and the concluding review of the international symposium on genetic effects of space environment are presented. (C.O.)

31954 THE GENE-CONTROLLED RADIATION SENSITIVITY IN YEAST. V. STUDIES ON UV-SENSITIVE MUTANTS AND THEIR CAPACITY TO PHOTOREACTIVATION. Fedorova, I. V. (Ioffe Inst. of Physics and Tech., Leningrad). Genetika; 5: No. 12, 120-8(Dec 1969). (In Russian).

Nine radiation-sensitive mutants of Saccharomyces cerevisiae were induced by uv light: seven were ultraviolet-light sensitive only, two were uv- and x-ray sensitive. Crosses between mutants showed that they carried non-allelic mutation to radiosensitivity. Ultraviolet radiosensitivity appeared to be a recessive monogenic character: heterosygous diploids were uv resistant and segregated as I:I into resistant and sensitive clones in the random ascospore samples. The genes uvs_1, uvs_2, uvs_3, uvs_4, xrs_2, xrs_4 have been identified among these mutations. In the haploid and diploid state, the mutations uvs_3, uvs_4 and xrs_4 increased the sensitivity to the lethal effect of uv radiation by a factor of 40, 20, and 2.5, respectively, compared to wild type haploid and diploid strains. The degree of uv sensitivity of mutants correlated with their higher capacity to photoreactivation. It is suggested that the mutations of radiation sensitivity blocked the system of dark recovery of uv-damaged DNA. (auth)

Health Physics and Safety

Refer also to abstracts 31537, 31539, 31632, 32031, and 32034.

31955 INDUSTRIAL HYGIENE HIGHLIGHTS. VOLUME I. Cralley, Lester V. (ed.). Pittsburgh; Industrial Hygiene Foundation of America, Inc. (1968). 394p. $20.00.

Separate abstracts were prepared for four of the chapters. Other subjects whose status of knowledge and practice are discussed in other chapters are: closed ecological systems; meteorology; analytical chemistry and instrumentation; engineering; ergonomics — heat and cold; noise; toxicology; personal protective devices; and health hazards of industrial processes. (C.O.)

For abstracts of individual chapters see: 31956, 31971, 32026, and 32258.

31956 IONIZING RADIATION. Schulte, Harry F. (Los Alamos Scientific Lab., N. Mex.). pp 118-39 of Industrial Hygiene Highlights. Vol. I. /Cralley, Lester V. (ed.). Pittsburgh; Industrial Hygiene Foundation of America, Inc. (1968).

The problems of ionizing radiation in the broad field of industrial hygiene are reviewed on the basis of brief comments and references over the field's spectrum. New developments of particular interest are emphasized. Topics briefly discussed in the review are: new uses of radiation, uranium mining, nuclear reactor fuel processing, external radiation dosimetry, dosimetry of internally deposited emitters, waste treatment, instrumentation, radiobiology and biophysics, medical aspects, personal protective equipment, and standards and regulations. (86 references) (C.O.)

Radioactive Contamination and Decontamination

Refer also to abstracts 31525, 31566, 31650, 31656, 31660, 31662, 31831, 31888, 31891–31893, 31895, and 31900.

31957 (AD-699382) EVALUATION OF PROTECTION ACHIEVED BY LIMITED STRIP DECONTAMINATION. PART 2. Final Report, May 9, 1967–December 31, 1969. Bryan, Fred A. Jr.; Paddock, Richard E. (Research Triangle Inst., Durham, N. C. Operations Research and Economics Div.). Contract N00228-67-C-2297. 129p. (RTI-R-OU-333-2). CFSTI.

A discussion is given of analyses utilizing the CONSTRIP V Computer Program performed for the purpose of decontamination operation guideline development. The theoretical calculations are described in summary form and principal results are presented. Also included is a description of a survey of essential facilities in the Detroit area, with accompanying analyses of these facilities to determine the effectiveness of limited strip decontamination operations. (auth) (USGRDR)

31958 (HASL-218) INDEX TO FALLOUT PROGRAM QUARTERLY SUMMARY REPORTS, 1958–1969. Rivera, Joseph (comp.) (New York Operations Office (AEC), N. Y. Health and Safety Lab.). 1 Jan 1970. 60p. Dep. CFSTI.

Interpretive reports and notes published in the HASL Quarterlies to date are listed. The listings are chronological, by topic in outline, and alphabetically by author. The listings by topic are not exhaustive, but may be used as guides to locate reports on specific subjects. (auth)

31959 (HASL-229) THE BIOLOGICAL EFFECTS OF TRITIUM. Woodard, Helen Q. (Sloan-Kettering Inst. for Cancer Research, New York). 18 May 1970. 49p. Dep. CFSTI.

A literature survey is presented on the following topics: tritium hazards to personnel of nuclear reactors; hazards to populations following nuclear explosions; hazards to personnel in biological and medical research; uptake and loss of tritiated water; incorporation of tritium from HTO into body components; model for computing radiation dose from acute acquisition of tritium as HTO by man; nature of biological effects of tritium; and mechanisms of biological effects of tritium. It is concluded that the types of possible human exposure to tritium fall into the following groups: acute exposure to large concentrations of tritiated water or tritium gas during accidents at nuclear reactors or during the manufacture of tritiated compounds; chronic exposure to low levels of activity in contaminated environments; and acquisition of tritiated compounds by laboratory personnel through accidental ingestion, injection, inhalation, or contamination of the skin. There is presently no evidence either from results of experiments in animals or from observations of human accident cases that any demonstrable somatic injury results from intakes of tritiated water at the maximum levels recommended by the ICRP. There is experimental evidence that tritium acquired as water can be incorporated stably into various tissue constituents. The incorporation of tritium into DNA can result in both somatic and genetic injury. Animals eating food grown in an environment contaminated with tritium will incorporate tritium into the DNA of any cells that are replicating at the time of exposure. (H.L.W.)

31960 (NIRS-RSD-22) RADIOACTIVITY SURVEY DATA IN JAPAN. Number 22. (National Inst. of Radiological Sciences, Chiba (Japan)). Feb 1969. 19p. Dep. CFSTI (U. S. Sales Only).

Data from monitoring of radioactivity in Japan is presented in two parts: data of routine survey and data of the eighth nuclear test of the People's Republic of China. Separate abstracts were prepared for each of the two sections. (C.O.)

For abstracts of individual sections see: 31488 and 31890.

31961 (NP-18056) EVALUATION OF ^{222}Rn NEAR URANIUM TAILINGS PILES. Final Report. (Bureau of Radiological Health, Rockville, Md.). Mar 1969. 74p. (DER-69-1). GPO.

The results of a joint PHS–AEC yearlong study to evaluate the public health aspects of atmospheric ^{222}Rn concentrations in the vicinity of uranium mill tailings piles are presented. Samples were collected from 13 onpile and 44 offpile stations in the four study cities of Grand Junction and Durango, Colo., and Monticello and Salt Lake City, Utah. The tailings pile at Monticello was covered and stabilized; the other three are uncovered and unstabilized. The side slopes of the pile at Grand Junction are partially stabilized with a grass cover. On the basis of the data gathered at the four study sites, it is possible to reach the following conclusions: The background ^{222}Rn concentration at Grand Junction averages 0.8 pCi/liter and is approximately double the background concentrations at the other three study sites. The tailings at the four study sites are not significantly affecting the atmospheric radon concentrations beyond a distance of one-half mile in the prevailing wind directions. Of the 44 offpile stations, exclusive of station 82 at Salt Lake City, only two exhibited an average radon concentration (above background) equal to or higher than the 1 pCi/liter screening value adopted for this study. The measured concentrations of radon over the stabilized tailings at Monticello are less than those over the other tailings in this study. Determination of the precise effect of stabilization would require sampling before and after stabilization at a specific site. The conclusions are: A technique for taking integrated air samples for radon near uranium tailings piles was developed, tested, and proven through use in the field. Atmospheric concentrations of radon in areas near uranium tailings piles were evaluated as an index to radiation exposure of the population. The results indicate no significant radiation exposure to the public from this source. Stabilization and covering of uranium tailings piles in theory should reduce the emanation of radon from the piles; however, the evi-

dence for this is not conclusive from data obtained during this study. Development of point recommendations to control public exposure to radon from uranium tailings piles is not necessary, as no significant public exposure was indicated by the results of the study. (auth)

31962 (NYO-2577-11) A STUDY OF NATURAL RADIOACTIVITY IN BRAZIL. (Pontificia Universidade Catolica do Rio de Janeiro (Brazil). Instituto de Fisica). Oct 1969. 25p. Dep. CFSTI.

Studies were made on the biological effects on the 6000 inhabitants of Guarapari who are exposed to chronic low level ionizing radiation which is 10 times normal natural levels. Emphasis has shifted to possible internal contamination and a Whole-Body Counter was constructed. The installation, calibration, and preparatory measurements are described. A 6 in. NaI crystal with phototube was used as the detector and the spectrum recorded on a 256 channel analyzer. Detection limits, minimum significant activities, energy calibration, spectral resolution, phantom calibration, data analysis, computer program for gamma-ray spectra scrambling, and results from the measurements of a sampling unit picked from one of the natural radioactive areas (Guarapari) are discussed. Data are tabulated. (J.C.W.)

31963 EVALUATION OF ^{226}RA IN TOTAL DIET SAMPLES, 1964 TO JUNE 1967. Shleien, Bernard (Northeastern Radiological Health Lab., Winchester, Mass.). Radiol. Health Data Rep.; 10: 547-9(Dec 1969).

The concentration of ^{226}Ra in diet samples collected by the Institutional Total Diet Network, Bureau of Radiological Health, is evaluated. A description of sampling and analytical procedures is presented. Results of three and one-half years of total diet surveillance at eleven geographical locations in the United States indicate that this procedure is adequate for evaluating ^{226}Ra intake of human populations. (H.B.G.)

31964 DATA. SECTION II. WATER. Radiol. Health Data Rep.; 10: 565-8(Dec 1969).

The average α and β radioactivity for the major river basins in the United States is reported. Monitoring of domestic water supplies is on a continuing basis. Most of the supplies sampled have, as a source, raw surface waters, although a few wells, along with some water supplies that use infiltration galleries, are also sampled. Methods for measuring α and β radioactivity are described and follow those recommended by the U. S. Public Health Service. (H.B.G.)

31965 DATA. SECTION I. MILK AND FOOD. Radiol. Health Data Rep.; 10: 489-505(Nov 1969).

The Pasteurized Milk Network, sponsored by the Bureau of Radiological Health and the Bureau of Compliance, Food and Drug Administration, U. S. Public Health Service, consists of 63 sampling stations. Sixty-one are located in the USA, one in Puerto Rico, and one in the Canal Zone. Additional networks for the routine surveillance of radioactivity in milk in the western hemisphere and their sponsoring organization are Pan American sample program with five stations and Canadian milk sample program with 16 stations. To determine the accuracy of each laboratory, milk samples containing known concentrations for ^{89}Sr, ^{90}Sr, ^{131}I, and ^{137}Cs are sent to the laboratories. Results for ^{131}I and ^{137}Cs are encouraging, but results for ^{89}Sr and ^{90}Sr need improvement. Concentrations of radioisotopes in milk for the period of August 1968 to July 1969 are presented in three tables. The dietary intake of selected radioisotopes is estimated by various Federal and state agencies. Presently existing programs are listed. In addition, one liter of milk and 2 kg of food samples are sent to the Public Health Service Northeast Radiological Health Laboratory where they are analyzed for ^{14}C, tritium, and ^{239}Pu. Findings are given in seven tables. (H.B.G.)

31966 DATA. SECTION II. WATER. Radiol. Health Data Rep.; 10: 507-14(Nov 1969).

The average α and β radioactivity for the major river basins in the United States during April 1969 is listed. For the state of Minnesota, α and β activity is determined monthly in the municipal water supplies and is listed in two tables. In addition, ^{90}Sr and ^{137}Cs content in tap water of New York City from July through December 1968 is tabulated. Tritium content in the major river basins in the United States is sampled periodically. (H.B.G.)

31967 DATA. SECTION I. MILK AND FOOD. Radiol. Health Data Rep.; 10: 551-63(Dec 1969).

The Pasteurized Milk Network, sponsored by the Bureau of Radiological Health and the Bureau of Compliance, Food and Drug Administration, U. S. Public Health Service, consists of 63 sampling stations. Sixty-one are located in the USA, one in Puerto Rico, and one in the Canal Zone. Additional networks for the routine surveillance of radioactivity in milk in the western hemisphere and their sponsoring organization are Pan American sample program with five stations and the Canadian milk sample program with 16 stations. To determine the accuracy of each laboratory, milk samples containing known concentrations for ^{89}Sr, ^{90}Sr, ^{131}I, and ^{137}Cs are sent to the laboratories. Results for ^{131}I and ^{137}Cs are encouraging, but results for ^{89}Sr and ^{90}Sr need improvement. Concentrations of radioisotopes in milk for the period of September 1968 through August 1969 are presented. The dietary intake of selected radioisotopes is estimated by various Federal and state agencies. Presently existing programs are listed. In addition, the average intake of ^{90}Sr by consumption of various foods is estimated. Results are given for the cities of New York City, Chicago, and San Francisco. (H.B.G.)

31968 DECONTAMINATION OF VEGETABLES AND FRUIT. Paulus, K. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Ind. Obst.-Gemueseverwert.; 53: 85-8(15 Feb 1968). (In German).

Various methods are considered for removal of surface contamination of vegetables and fruits with ^{85}Sr and ^{137}Cs and the results obtained discussed. The methods considered included chemical procedures, such as washing with water or decontamination solutions, and physical methods such as rubbing, brushing, peeling, or covering with a plastic layer and then removing this layer. With contaminated potatoes, hand or machine peeling and peeling with lye removed 100% of the surface ^{85}Sr and ^{137}Cs. Washing and brushing removed 70 to 98% of these radioisotopes. Soaking in water removed only 15 to 20% of the contamination from carrots. Cooking removed 41 to 58%, while scraping and washing removed 98% of the radioisotopes. Washing and brushing removed 60 to 65% of the radioisotopes from cucumbers, a plastic sheet removed 15 to 25%, and peeling removed 100%. Spinach and leek were difficult to clean by these methods. Washing and brushing of apples removed 65% to 80% of the contamination, a plastic sheet removed 20% to 45%, and peeling removed 100%. (BBB)

31969 MONITORING OF EXPOSURE TO HIGH-ALTITUDE IONIZING RADIATION AND OF RADIOACTIVE CONTAMINATION IN LONG-RANGE AIRCRAFT. Moroni, J. P.; Pellerin, P.; Ervet, P.; Medvedeff, M.; Borrey, F. (Institut National de la Sante et de la Recherche Medicale, Le Vesinet, France). Bull. Inst. Nat. Sante Rech. Med.; 23: 1165-98(1968). (In French).

With the collaboration of Air-France and Union de Transports Aériens, French air companies, the SCRPI, since the autumn of 1961, has been running a network of survey of the external irradiation and internal contamination occurring during high altitude flights, owing to cosmic radiation and high atmosphere contamination linked to nuclear tests. Several thousand results have been obtained up to now. The conclusions drawn from their analysis allow, particularly, a look at the extension of this survey to the future supersonic flights. (auth)

31970 RADIATION SAFETY PROBLEMS WITH THE DOUBLE ISOTOPE ASSAY OF ALDOSTERONE. LeBlanc, Adrian D. (Baylor Coll. of Medicine, Houston, Tex.); Johnson, Philip C.; Perkins, Billy C. Health Phys.; 18: 78-80(Jan 1970).

Laboratory and personnel contamination is reported arising from volatilization of ^{3}H compounds when double isotope derivative procedures are used for the measurement of testosterone, progesterone and aldosterone. This contamination was largely eliminated by installing a laboratory hood with a linear velocity across the face of 220 ft min^{-1} and a flow of 1800 ft^{3} min^{-1}. Tests are also reported on excretion of absorbed tritiated acetic acid which was shown to have multiple half times making estimation of absorbed dose difficult. (UK)

31971 AIR POLLUTION. Clayton, George D. (George D. Clayton and Associates, Inc., Detroit). pp 271-96 of Industrial Hygiene Highlights, Vol. I. /Cralley, Lester V. (ed.). Pittsburgh; Industrial Hygiene Foundation of America, Inc. (1968).

The approach to solving air pollution problems in the United States as declared by both the Republican and Democratic parties is presented and the eight designated atmospheric areas covering 48 of the states are described. The growth and accomplishments of governmental air pollution activities (in relation to state, local, and regional programs) with regard to automobile exhaust control, atmospheric content of suspended particulate matter, beta radiation, and gases and air quality standards are discussed. The methodology of control as affected by engineering technology and social problems concludes the discussion on air pollution. (C.O.)

31972 RECOMMENDATIONS RELATIVE TO THE MAXIMUM PERMISSIBLE CONCENTRATIONS OF TRITIUM OXIDE IN THE AIR OF INDUSTRIAL SITES. Moskalev, Yu. I.; Shtukkenberg, Yu.

M.; Zhuravlev, V. F. Gig. Tr. Prof. Zabol.; 13: 39-43(Feb 1969). (In Russian).

Data are presented on the half-life of tritium oxide passed from the human organism and some information as to its comparative biological effectiveness. Some rated figures as to the access of tritium oxide into the human organism are listed. A new level of the maximum permissible concentrations of tritium oxide in the atmosphere of industrial premises, in expired air, and in urine is recommended. (auth)

31973 RADIATION AND ENVIRONMENTAL CHARACTERISTICS OF THE ACTINIDE ISOTOPES. Arnold, E. D. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 219-20(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

31974 ON THE OCCURRENCE OF ^{90}Sr IN BIOLOGICAL MATERIALS. Keil, R. (Univ., Rostock, Ger.). Nahrung; 12: 399-405(1968). (In German).

Radiochemical studies on the bones of carps of three summers (time of catching: December 1961 and October 1962) from ponds in Mecklenburg yielded ^{90}Sr contents of nearly 5 pCi/g Ca or 2 pCi/g ash or 370 pCi/kg fresh matter. Bones of chickens (year of rearing: 1965) contained (mean values): 2.9 pCi ^{90}Sr/g ash or 725 pCi/kg fresh matter or 7.7. strontium units. The respective values for chicken-meat were: 0.39, 3.9 and 10. Thus, the contamination rate of bones was 186 times that of meat. The causes of the considerable higher ^{90}Sr content of the meat of fresh-water fishes, as compared with that of the meat of salt-water fishes, warm-blooded animals and chickens, and of the surprisingly high per head ingestion of radiostrontium by the consumption of fresh-water fishes is discussed on the basis of the respective West German findings. (auth)

Dosimetry and Monitoring

Refer also to abstracts 31472, 31486, 31488, 31508, 31511, 31551, 31565, 31681, 31682, 31687, 31688, 31702, 31706, 31731, 31737–31739, 31746, 31747, 31808, 31890, 31894, 31972, 32057, 32062, 32063, 32104, 32113, 32116, 32117, and 33076.

31975 (AD-691153) NEUTRONS IN RADIOBIOLOGICAL EXPERIMENTS. Isaev, B. M.; Bregadze, Yu. I. Translated from pp 1-292 of Neitrony v Radiobiologicheskom Eksperimente [Izdatel'stvo Nauka], Moscow, 1967. 297p. (FTD-MT-24-258-68). CFSTI.

The methodology of radiobiological experiments using radioactive isotopes as neutron sources is discussed as are accelerators and reactors. The physical mechanisms of neutron interaction with biological objects and methods of measuring and calculating the absorbed doses are considered. The quality of irradiation, determined by its biological effectiveness is studied in detail. Measuring and calculating the distribution of absorbed doses according to line at energy loss is discussed. These parameters characterizing the interaction of radiation with the material must be considered during the formulation of qualitative radiobiological investigations. (TAB)

31976 (ANL-7489, pp 37-43) SOURCES OF ^{210}Pb IN URANIUM MINERS. Holtzman, Richard B. (Argonne National Lab., Ill.).

Correlations between ^{210}Pb concentrations in bone and estimated exposure of uranium miners to Rn daughters were analyzed. Sources of ^{210}Pb considered were Rn daughters, ore dust containing ^{210}Pb and ^{226}Ra more or less in a state of radioactive equilibrium with U, long-lived daughters in mine atmosphere, ^{222}Rn dissolved in body tissues, ^{222}Rn adsorbed in mine dust and recirculated, and normal levels derived from food, water, tobacco smoke, and the atmosphere. Results are presented in tabular form and discussed in relation to radiation dose and radiation effects. (C.O.)

31977 (ANL-7489, pp 116-17) ECOLOGICAL DOSIMETRY. Kastner, J.; Oltman, B. G.; Ashby, W. C.; Paden, C. (Argonne National Lab., Ill.).

The feasibility of using lithium-7 fluoride thermoluminescent dosimeters under field conditions for determination of natural radiation at levels of less than 5 mR was reevaluated. Pairs of ^{7}LiF dosimeters consisting of extruded rods 1.4 × 1.4 × 7.0 mm (37.5 mg) were encapsulated in Al tubing ~20 mm long by 5 mm wide (wall thickness of 1 mm). Ends were mechanically pinched and sealed with wax. The accumulated γ-exposure dose as a function of time was determined for a live oak, a dead oak and an area one m under the ground; and results are presented graphically. Small variations in dose rate as well as the difference between live and dead trees were considered to be related to the effects of moisture and hydrogenous ground cover in shielding the dosimeters from terrestrial γ rays. (C.O.)

31978 (ANL-7489, pp 117-24) THERMOLUMINESCENCE IN BONE AND BONE-LIKE MATERIALS. Bordell, F. L.; Kastner, J. (Argonne National Lab., Ill.).

The attempt to use bone, tooth enamel, and dentine as self-dosimeters via thermoluminescence techniques is described in this paper. Although some specimens exhibited thermoluminescence, many did not, and the condition of preparation played a major role for those that did. High temperature treatment prior to radiation exposure has proved to be best for radiation-induced thermoluminescence, but such treatment is the least desirable for using these materials as natural thermoluminescent dosimeters. Two separate read-out methods were employed: the ordinary heat-ramp application as used in commercial TLD instrumentation, and integration of light intensity at room temperature as a function of time. The results indicate that bone and similar materials do not have sufficiently reliable thermoluminescent properties to make their use as self-dosimeters possible. (auth)

31979 (BARC-426) ANNUAL GAMMA DOSAGES IN TROMBAY ENVIRONMENT DUE TO ^{41}Ar FROM CIRUS REACTOR. Shirvaikar, V. V.; Sitaraman, V.; Sastry, P. L. K. (Bhabha Atomic Research Centre, Bombay (India)). 1969. 14p. Dep. CFSTI (U. S. Sales Only).

The radioactive effluents from stacks at nuclear reactor sites should be limited such that the total environmental dose to individual members of the public does not exceed 0.5 R/year or its fraction apportioned to the dose through air route. The extent of the dose received at any point can be evaluated in two ways; directly by continuously operating radiation recorders or indirectly from meteorological data. In this paper, a comparison of the methods is made using measurements at Trombay with certain reasonable assumptions about the effective stack height in view of uneven terrain. The agreement between the two for γ doses is satisfactory, justifying the validity of indirect estimates from meteorological data which have the added advantage that from a single station data estimates of entire dose field in the environments may be made at low cost and without the serious operational difficulties faced in continuously operating radiation monitors. These estimates also indicate areas where more intensive surveying is required. (auth)

31980 (BRH/DEP-70-5) A STUDY OF HEAD AND NECK EXPOSURES FROM PANORAMIX ROENTGENOGRAPHY. McMahon, James J. (Bureau of Radiological Health, Rockville, Md. Div. of Electronic Products). Mar 1970. 39p. CFSTI.

A study was made of body organ exposures resulting from maxillo-facial panographic procedures using the Panoramix, an intracavitary radiographic machine. Diagnostic examinations were simulated on a phantom and performed on several patients under laboratory conditions. Thermoluminescent dosimeters were placed at selected internal and external sites of a phantom human bust and at corresponding sites on several dental patients. Various operating parameters and techniques were used and the radiation at various locations was measured. The laboratory and clinical experiments were closely coordinated in order to compare data. The intraoral panoramic method gave exposures to eyes, thyroid, and certain ectodermal tissues comparable to exposures from conventional complete mouth intraoral examinations and gave additional valuable diagnostic information. The basis for comparison was the diagnostically acceptable radiograph. (auth)

31981 (CEA-N-1245) NEUTRON BEAM DOSIMETRY APPLIED "IN VIVO" ACTIVATION ANALYSIS. Sklavenitis, Helene; de Beaucourt, Philippe; Lott, Michel (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan 1970. 19p. (In French). Dep. CFSTI (U.S. Sales Only).

A dosimetric study was made in order to perform an in vivo localized irradiation on a person using a focused beam of thermal neutrons produced in the H 7 channel of the Saclay EL 3 reactor. Measurements of the thermal, epithermal and fast neutron flux were made with Au, S, Ni and Rh threshold detectors. The average energy of the thermal and fast neutrons was then determined. The various components of the absorbed dose were first evaluated from the measured fluxes and from the interaction mechanisms of neutrons with biological matter. Also, the dose due to the fast portion of the beam was measured with a Bonner sphere. Measurements were then made of the total dose rate and of the dose rate due to both the gamma radiation coming directly from the reactor core and the fast fraction of the beam; these measurements were made with ionization chambers of various materials. The results were compared. The rate of the dose absorbed by the skin of a person irradiated by the beam under examination, for a

thermal flux in the central zone of the beam of 1.25×10^8 n. cm sec^{-1} and for a fast neutron flux of 2.25×10^5 n. cm^{-1}, was found to be: (a) dose due to the reaction $^{14}N(n,p)^{14}C$: 175 mrad/min; (b) dose due to capture gammas : 180 mrad/min; (c) dose due to direct gamma radiation : 8 mrad/min; (d) dose due to fast neutrons : 55 mrad/min. (France)

31982 (CEA-R-3994) DOSE ABSORBED IN BIOLOGICAL TISSUE IRRADIATED BY FAST MONOENERGETIC NEUTRONS. Sklavenitis, Helene; Devillers, Christian (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Apr 1970. 37p. (In French). Dep. CFSTI (U. S. Sales Only).

The dose absorbed in an irradiated biological tissue equivalent medium is calculated with a view to carry out radioactivation quantitative analysis with fast monoenergetic and unidirectional neutrons. The results are compared to those of a similar American work at energies of 10, 2, and 0.5 MeV. The method is then applied to neutrons of 14.75 and 3.6 MeV. (France)

31983 (CISE-N-128) EXPOSURE OF CHILDREN OF 18 YEARS OF AGE TO IONIZING RADIATION. Bazzano, E.; Ghislandi, E. (Centro Informazioni Studi Esperienze, Milan (Italy)). Sep 1969. 14p. (In Italian). (CONF-690929-1). Dep. CFSTI (U. S. Sales Only).

From 15th National Congress of the Italian Association for Health Physics and Protection against Radiation, Cagliari, Italy.

The particular aspects of the exposure of 18-year old minors to ionizing radiation both from professional activity and from study and training were considered. After a discussion of the motives for which both the Euratom Standards and the laws of many countries (of which Italy is one) prohibit the professional exposure of such persons, the problems of students, especially those in nuclear engineering schools, who participate in exercises with radiation sources and in periods of practical instruction at nuclear installations, are examined. The criteria that can be followed to establish the dose limits to which these students can be exposed are examined from the viewpoint of a rigorous radioprotection. (tr-auth)

31984 (DOCKET-50201-26) [WEST VALLEY REPROCESSING PLANT]. Environmental Radioactivity in New York State, 1968. (New York State Dept. of Health, Albany). 14 Jul 1969. 24p. Dep. CFSTI.

31985 (NP-18121) ANNUAL REPORT TO THE DIRECTOR-GENERAL FOR THE YEAR ENDED 30th JUNE 1969. (Commonwealth X-Ray and Radium Lab., Melbourne (Australia)). 1969. 42p. Dep. CFSTI (U. S. Sales Only).

The historical and present-day responsibilities of the Laboratory are discussed and the developments during the year are reported. Progress is outlined in the fields of national standards of activity of radionuclides and of exposure to x and γ radiation, radiation dosimetry, diagnostic radiology, radium, radon, radioisotopes, radiochemistry and low-level measurements, whole-body monitor, radiological protection, and film-badge service. Appendixes provide information on statistical data for radiochemistry and low-level measurements, radioisotopes, radon, and radium, as well as the procedures for procurement of radioisotopes for medical research in Australia. (C.O.)

31986 METHODS OF COMPUTER CALCULATION OF DOSE DISTRIBUTIONS IN TELETHERAPY. Cunningham, J. R. (Ontario Cancer Inst., Toronto). pp 19-24 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

Dose distribution computations have been carried out for many years both for purposes of on-line production of data to be used directly for patients and to produce atlases and analyses of data. In this work, the computer has not merely done more quickly what can be done with a slide rule or a desk calculator, but has made possible the inclusion of such factors as, for example, three-dimensional representations and allowances for tissue inhomogeneities. The central problem is always the determination of the dose at any point in an absorbing and scattering medium for a single beam. Multiple-beam distributions are combinations of single beams. The single beam has been represented by digitized isodose data, or by empirical generating functions, or by use of decrement lines, or by separation of scattered and primary radiation. There has been little program interchange among workers in this field; each worker has followed his own methods, the type of program used being frequently determined by available computer facilities. At present it is likely that the greatest need is for information concerning the patient, i.e., contour, localization, extent of tumor, and body inhomogeneities, and for accurate methods of beam direction. It is likely that the computer can assist in dealing with all these points. (40 references.) (auth)

31987 COMPUTER DOSIMETRY FOR INTERSTITIAL AND INTRACAVITARY IMPLANTATIONS. A SURVEY. Stovall, Marilyn (Anderson Hospital and Tumor Inst., Houston, Tex.); Shalek, R. J.; Peterson, Mary. pp 25-35 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

Fourteen digital computer techniques for the dosimetric evaluation of interstitial and intracavitary applications of sealed radioactive sources are reviewed; eleven of these programs were designed for routine calculation of dose distribution in individual patients and three programs are special-purpose. The techniques used for routine computations are compared in terms of method of obtaining input data, types of sources considered, method of calculation, and form of output data. The similarity between these methods reveals a fundamental agreement among workers concerning the basic approach to the problem. The principal differences appear in the form of output data, but these largely reflect the hardware capabilities available at various institutions. Five figures illustrate some forms of output data in use at present. (37 references.) (auth)

31988 COMPUTER CALCULATION OF DOSE DISTRIBUTIONS IN ^{60}Co TELETHERAPY. Houdek, P. (Oncological Inst., Prague); Hron, M. pp 39-45 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

The use of Sterling's non-linear equation for the calculation of two- and three-dimensional dose distribution is briefly described. The role of the sigma constant, a function of penumbra width, as it affects the construction of a ^{60}Co unit is discussed. Dose distributions as calculated with a Gier computer are presented. (40 references.) (auth)

31989 AN IMPROVED MODEL FOR RECTANGULAR ^{60}Co GAMMA RADIATION BEAMS IN UNIT-DENSITY MEDIA. Van de Geijn, J. (Ziekenhuis van den H. Johannes de Deo, The Hague). pp 47-51 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

A point-source model for rectangular ^{60}Co beam γ dose distribution in a water-equivalent medium proved to be sufficiently accurate for clinical purposes. The principal shortcomings of this model occurred in the region of the beam penumbra near the surface of the medium. A description is given of a relatively simple improvement of the model. It is based on an analysis of the geometry of the source, collimator walls, aperture, and patient (or phantom). The new model provides a reasonably accurate quantitative description of the behavior of decrement lines, based on computer calculations of dose distribution. (C.H.)

31990 BEHAVIOUR OF ZONAL INTEGRAL DOSE IN HIGH-ENERGY MOVING-FIELD TELETHERAPY. Van de Geijn, J. (Ziekenhuis van den H. Johannes de Deo, The Hague). pp53-66 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

Some initial results are reported on the use of two parameters which may be useful in judging the relative quality of treatment plans and the relative merits of high-energy radiation machines used for moving-field γ therapy. These two parameters are zonal integral dose and zonal surface area. These concepts are based on a comparison of the dose to the target volume with the dose to a certain critical region surrounding it, using computer calculations. Attention is limited to a few moving-field techniques, where the target volume is defined by the 80% isodose surface. In the tissue surrounding the target volume, the 60 to 70% and 70 to 80% regions were investigated. Some results are given on the effect of field size and other factors for four different teletherapy machines: three ^{60}Co units and one linear accelerator. Performances of these machines are compared. (C.H.)

31991 PROGRESS IN OPTIMIZATION BY SCORE FUNCTIONS. Hope, C. S. (Western Regional Hospital Board, Glasgow); Laurie, J.; Orr, J. S.; Halnan, K. E. pp 67-9 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

Two aspects of the current development of a system for optimized γ radiotherapy treatment planning by computer are discussed. The representation in the system of the conflict between effective dose to the tumor and minimum morbidity elsewhere is undergoing a reappraisal. In the present system using six judgement criteria, two are concerned with treatment of the tumor and four with minimizing undesirable effects. The present method of combining them is such that if a serious imbalance develops between the number of criteria in each category, the system would become biased. Score functions and a method of combining them must, therefore, be developed which systematically consider the balance between the conflicting aims. The second aspect of current development of the system is a re-definition of the intention and potential of the system. Based on the same radiotherapeutic concepts, the system favors the same treatments as are selected by human experience; however, in addition, the interaction of the system with its operators stimulates an extension of the basic concepts of goodness in a treatment plan. The system's most important contribution is based on computer calculations. (C.H.)

31992 COMPUTER-AIDED EVALUATION OF TISSUE ABSORPTION MEASUREMENTS. Rosenow, U. (Univ., Goettingen, Ger.). pp 71-6 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

The main difficulties in computerized external-beam γ dose calculations at present are the derivation of the exact outlines of tissue inhomogeneities, and the measurement of their densities. The lack of a physical description of radiation beams within and behind inhomogeneities can be overcome by approximations. Absorption measurements in the female pelvis were made by inserting a small ^{60}Co source into the vagina while performing a circular scanning technique. The measurements were compared with measurements made in water. Considerable differences in absorption were found, e.g., at frontal positions, deviations were between 10 and 20%, but in single cases much higher. The outline of bone was measured by x-ray-stereophotogrammetry. It is suggested that tomography be used. For more accurate work, x-ray-stereophotogrammetry supported by a standard anatomical cross-sectional atlas for the derivation of bone and lung outlines, together with a rotational scanning technique are recommended. All measurements should be taken with the patient in the treatment position. (auth)

31993 APPROXIMATION AND VARIATION OF HUMAN BODY SURFACE FOR THREE-DIMENSIONAL DOSE CALCULATION IN TELETHERAPY. Busch, M. (Univ., Freiburg i.B.). 77-91 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

A mathematical model of the human body with variable geometry was developed for dose-calculation purposes. The model is composed of several overlapping ellipsoids. It can be adapted to the proportions of any individual patient by means of a few sample measurements of the patient's body. The ellipsoidal model allows for a simple representation of the human body surface in three dimensions with sufficient accuracy for purposes of teletherapy. An extension of this mathematical model to allow consideration of body inhomogeneities is discussed. (50 references.) (auth)

31994 COMPARISON OF MEASURED AND CALCULATED RADIUM DOSE DISTRIBUTIONS. Busch, M. (Univ., Freiburg i. B.). pp 93-8 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

Radium dose distributions are generally calculated by solving the Sievert's integral which assumes an exponential absorption of radium γ rays in the platinum sheath. Whyte showed that the attenuation of radium γ rays in platinum is, however, not exponential. Modern computer methods now enable the extension of the Sievert's integral to the more universal screen integral or envelope integral which permits consideration of any absorption curve and thus is not limited to exponential absorption. It is shown that neither the exponential curve nor the absorption curve of Whyte agree with measured dose distributions. The best results are shown to follow an empirical absorption curve adapted from the isodose measurements of Hine and Friedman, which may be represented by a polynomial. (23 references.) (auth)

31995 IMPACT OF THE COMPUTER ON THE ORGANIZATION OF RADIOTHERAPY. Cohen, M. (London Hospital). pp 101-7 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

It is impossible to generalize as to the likely effect of the introduction of a computer into radiotherapy treatment planning: the impact may be profound or negligible, or anything in between. The problem is discussed under four headings: including the type of radiotherapy undertaken; number of cases to be calculated; training and outlook of staff; and purpose of treatment planning. Fears are often expressed that the training of radiotherapists and radiation physicists will suffer when treatment planning is computerized. This fear is groundless. On the contrary, training can be extended and improved when the time-consuming labor of graphical addition of isodoses is made unnecessary. The computer will enhance, rather than remove, the need for trained personnel at all levels, and this must be borne in mind especially by radiotherapy centers in developing countries. In the next decade the most likely impact of the computer in these centers lies in the greatly increased provision of pre-calculated data in atlas form. (auth)

31996 EFFECTS OF COMPUTERS ON RADIOTHERAPY. SOME OBSERVATIONS. Hope, C. S. (Western Regional Hospital Board, Glasgow); Orr, J. S.; Hainan, K. E. pp 109-12 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

A comparison is drawn between the application of technological advance to the practice of radiotherapy and the automation of an industrial process. Three main points emerge: First, the benefit from a complete systems analysis, which is essential before a process can be automated, has not been attained in radiotherapy where the practical application of computers has so far been concentrated in one part of the treatment system. The second point arises from general economic considerations. In industry, the application of automation must result in significant economies or the automation will not be carried out. In radiotherapy, however, technology dictates the order in which improvements can be introduced. Finally, in automating a multi-stage process, the links between stages require as close a study as the stages themselves. This is equally necessary in the improvement of radiotherapy as a system where a range of man/machine interface problems occur, some of which can be dealt with by current developments in the use of computers. (auth)

31997 IMPACT OF COMPUTERS IN RADIOTHERAPY. Massey, J. B. (Christie Hospital and Holt Radium Inst., Withington, Eng.). pp 113-25 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

Consideration of the basic intentions and activities of radiotherapy shows that, although the computer is useful for investigating dose distributions as well as the effects of controlling factors, there is no necessity for it in day-to-day external-beam therapy. For interstitial and intracavitary work some day-to-day use is advantageous. Control of exposure and beam positions in the delivery of x-ray treatments, although possible, is expensive and could not be available universally in the foreseeable future. Computer storage of records is immediately advantageous and is of paramount importance for the analysis of results. Although there need be little change in organization, staffing, and training of those involved in the actual treatment (except for a little additional training in the use of computers), great changes will be required for the documentation and analysis aspects of the work. (auth)

31998 REPORT OF COMMITTEE IV ON EVALUATION OF RADIATION DOSES TO BODY TISSUES FROM INTERNAL CONTAMINATION DUE TO OCCUPATIONAL EXPOSURE. RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. ICRP Publication 10. New York; Pergamon Press (1968). 98p.

Amplification of paragraph 86 of ICRP publication 6 concerning monitoring studies of personnel was done by a task group. Their report is presented in four sections: metabolism of radionuclides (entry into body, translocation and deposition, elimination); monitoring methods and programs; calculation of radiation dose; and indication for investigation (investigation levels, derived investigation levels, and subsequent investigations). Three appendixes are provided: tabulation of metabolic information from ICRP publications 2 and 6; mathematical formulation of retention of radionuclides; and data on individual radionuclides. (C.O.)

31999 MATHEMATICAL MODEL OF THE NEUTRON FLUX FOR THE NEUTRON CAPTURE THERAPY OF THE MALIGNANT TUMOR. Ueno, Yori; Ueno, Sueo (Kyoto Univ). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 389-91(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A mathematical model is described that was developed for use in estimating the radiation dose to malignant tumors in the brain during neutron capture therapy. A nuclear reactor is postulated as the neutron source and boron the material for neutron capture. Two-point boundary value problems were used in the calculations. (C.H.)

32000 EFFECT OF CURES OF PERIPHERAL VASCULAR DISORDERS AT THE BAD BRAMBACH NATIONAL RADON SPA. Herrmann, D. B. (Staatliche Zentrale fuer Strahlenshutz Berlin). Deut. Gesundheitsw.; 23: 1953-4(10 Oct 1968). (In German).

Radioactivity units were compared with units used for measurement of balneologic quantities. The balneological effect unit was established as an Rn activity concentration of a fluid or gaseous probe, representing the activity of a specific amount of Rn, measured in Ci/l. The activity concentration of 1 effect unit was defined as the amount of Rn dissolved in 1 l. of fluid or gas that produced by ionization a saturation current of 3.336×10^{-13} amp. The activity of this amount of Rn corresponded to 3.64×10^{-10} Ci/l. Another balneological unit of activity concentration that was defined was the eman. An activity of 1 eman was defined as the amount of Rn in l. of air or water whose activity was 10^{-10} Ci/l. Thus, 1 eman, 0.275 effect unit, and 10^{-10} Ci/l were equivalent to each other. (BBB)

32001 RADIATION EXPOSURE IN JAW ORTHOPANTOMOGRAPHY. Tammisalo, Erkki H.; Karhuvaara, Yrjo S. Rev. Dent. Liban.; 19: 75-85(Apr-Jun 1969).

An examination of the distribution of radiation on the head surface and within the head in the course of orthopantomography was made, and, further, a comparison was made with the skin dosages received in the conventional 14-film dental technique and in jaw orthopantomography respectively. The dosage in the latter case is found to be only about one third that in the conventional technique, even though the roentgenographed area involved comprises not only the full-mouth but in addition both jaws in toto. (auth)

32002 FREE-AIR MEASUREMENTS OF THE EMANATION DAUGHTER PRODUCTS BY MEMBRANE FILTERS. Hoehle, R.; Wetzstein, E. (Institut fuer Angewandte Radioaktivitaet, Leipzig). Isotopenproxis; 5: 455-61(1969). (In German).

The concentration of various emanation daughter products in free air has been determined by membrane ultrafilters of "Synpor" type. The alpha activity decay curve of the filters was measured and evaluated by a graphical-mathematical technique. A detailed summary of the theory of this evaluation is given. The numerical results of the measurements obtained by "Synpor 6" type filters (mean pore size 0.4 μm) are compiled in detail. The error limits in determining the various daughter products show that sufficiently exact determination of the RaA (^{218}Po), RaB (^{214}Pb) and ThB (^{212}Pb) concentrations in free air is possible under the experimental conditions described. (auth)

32003 STRUCTURAL CHARACTERISTICS AND THE EXPOSURE RATES IN THE JAPAN'S GAMMA FIELD. Kawara, Kiyoshi (Inst. of Radiation Breeding, Ibaraki, Japan). Gamma Field Symp.; No. 6, 1-18(1967).

From Symposium on Use of Chronic Irradiation in Mutation Breeding, Ibaraki, Japan. See CONF-670739.

The structure and operation of Japan's gamma field are described. Exposure rates were measured at various horizontal and vertical distances from the cobalt-60 source. Dosimetry close to the source, shielding by the iron legs of the irradiation tower, exposure rates underground, shielding by plants, scattered radiation in the off-limits area and on the road from remote control room to the off-limits area, and exposure rates on the lead container and in the remote control room were also reported. (M.M.B.)

32004 SOME DOSIMETRIC AND RADIATION PROTECTION ASPECTS OF CELLULAR IRRADIATION FROM INCORPORATED RADIOACTIVE MATERIALS. Oliver, R. (Churchill Hospital, Oxford). pp 165-85 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

In looking for any contribution of recoil or transmutation processes with internally deposited radioactive isotopes by comparison with the biological effects following gamma radiation exposure to produce the same absorbed dose, the various factors affecting local energy deposition must be carefully considered. For the same activity per unit volume of culture medium a higher specific activity results in increased nuclear incorporation and resultant cell lethality. Also for materials localized in the nucleus only (e.g., thymidine) the dimensions of the deposit may limit the nuclear dose, so that although ^{14}C disintegrations release some ten times more energy than ^{3}H, the biological effects demonstrated for the same nuclear activity (in μCi) are similar. Although the ICRP Recommendations give a QF of 1.7 for ^{3}H beta particles, published results vary from 1.0 to about 2.0. Recent experiments using both mammalian cells in culture and bean roots have shown clearly that the RBE varies with dose rate, from unity for dose rates of 1 rad/min or above to 1.7 for dose rates of about 1 rad/h, a conclusion which is in fact in agreement with other published results. In this connection the local energy distribution is considered theoretically for ^{3}H disintegrations and for gamma radiation, using in the latter case the data published by Rossi. If for a similar nuclear dose ^{3}H beta particles have an RBE of unity relative to gamma radiation, it appears that there is no significant extra contribution to damage from recoil or transmutation processes. As ^{14}C appears to be no more damaging than ^{3}H under similar conditions the same conclusion also applies for this nuclide. (auth)

32005 BEHAVIOR OF FAST ELECTRONS HITTING THE BODY IN A SLANTED DIRECTION. Vogel, Karl-Heinz (Univ., Tuebingen, Ger.). Strahlentherapie; 138: 556-9(Nov 1969). (In German).

The influence of oblique incidence on the dose distribution of fast electrons has been studied within a lamellated plexiglas phantom using film dosimetry. The results show that even in the first third of penetration, the dose is modified with a displacement in the direction of the incident angle. The dose is no longer modified in greater depth. The overall penetration range of the electrons is slightly reduced. (auth)

32006 DOSE DISTRIBUTION WITH A WEDGE FILTER IN ^{137}Cs TELETHERAPY. Kuttig, Helmut; Lehnert, Dieter; Mai, Karl Eugen; Wieland, Cuno (Univ., Heidelberg). Strahlentherapie; 138: 571-5(Nov 1969). (In German).

The dose distribution obtained in telecesium therapy is described, when a wedge filter of a 13.5° angle is used in normal and oblique incidence. The effect of the filter on the dose rate is shown. (auth)

32007 PRINCIPLES OF RADIOACTIVE DECAY LAW. Busch, Manfred; Popp, Fritz (Univ., Marburg, Ger.). Strahlentherapie; 138: 593-4(Nov 1969). (In German).

The law of radioactive decay is based on the axiom of the statistical probability of the disintegration of any atom per time unit. This hypothesis includes the physical fact of the independence of each atom concerning its disintegration. The correlation between probability of the decay of a radium atom per time unit, half-life of radium, and the Curie unit is discussed. (auth)

32008 AN ANALOGUE SYSTEM FOR THE COMBINATION OF ISODOSE CURVES IN MULTIFIELD RADIATION. Pape, Ulrich (Staedtische Krankenhauses Moabit, Berlin). Strahlentherapie; 138: 576-85(Nov 1969). (In German).

An automatic method is described to obtain composite isodoses for multi-field treatment techniques. Procedure modification of the parameters is possible that rapidly gives the optimal treatment plan for each patient. The dose distribution of every static field is reproduced in an appropriate way on a photographic film. By superposing the different films by an optical system it is possible to obtain transmission curves corresponding to the composite isodoses for the particular treatment technique. The use of a television system draws the isodose lines on the screen directly by modifying the signals in an appropriate way and identifies the isodoses by using different brightness or screen colors for the areas between them. The electronic system is built of integrated circuits. (auth)

32009 STUDIES ON INDIVIDUAL DEVIATIONS IN DOSE DISTRIBUTION FROM THE STANDARD DISTRIBUTION. I. 2- AND 4- AXIAL PENDULUM RADIATION TO THE SMALL PELVIS. Eichhorn, Hans-Juergen; Richter, Juergen (Deutsche Akademie der Wissenschaften, Berlin). Strahlentherapie; 138: 560-70(Nov 1969). (In German).

A study of the possible error was done by using one standard dose distribution established for a standard phantom, on a patient cross section with different dimensions, during moving beam telecobalt therapy for gynecological tumors. The influence on the dose distribution of the dimension and form of the cross-section, the axis depth, and the interposition of bone were studied with a computer. It was observed that the maximal error made was of the order of 10% with different cross sections, but of the order of 22% when the skeletal interposition was not taken in account. When standard isodose distribution was established for

five different situations instead of one, the errors could be reduced to less than 8%. The dose rate at axis must, however, be estimated for each individual patient. (auth)

32010 EXPERIMENTS ON THE DETERMINATION OF QUALITY OF OPTIMAL RADIATION FOR THE IRRADIATION OF THE LIMBS OF ANIMALS. Hartung, K.; Blaurock, H.-M. (Freie Univ., Berlin). Berlin. Muenchen. Tieraerztl. Wochenschr.; 82: 86-8(Mar 1969). (In German).

Measurements were made on a model to find out the absorption of roentgen rays within the leg of a horse, and these were then compared with tables of values for radiation of softer parts. The harder the radiation is, the nearer the soft part and bone absorption compare. On the basis of similar absorption of hard radiation and the relatively slight strain on the skin, it is suggested that when using roentgen therapy on the legs of larger animals the quality of radiation to be chosen should be that which provides the hardest radiation. (auth)

32011 THE INTERNAL AND EXTERNAL BREMSSTRAHLUNG OF ^{90}Sr (^{90}Y) IN RELATION TO THE IN VIVO MEASUREMENT OF THE WHOLE BODY BURDEN. Lenger, Vladimir (Inst. of the Radiation Hygiene, Prague). Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove; 11: 441-52(1968).

The method of measurement of the whole-body burden of ^{90}Sr (^{90}Y) in man by means of the bremsstrahlung of ^{90}Y and a method for complex analysis of gamma spectra are described. The influence of the internal bremsstrahlung is demonstrated. (auth)

32012 FIRST PHYSICAL SURVEY OF WISCONSIN DENTAL X-RAY INSTALLATIONS. Nelson, George B. (State Board of Health, Madison, Wis.). J. Wis. State Dent. Soc; 43: 279-80 (Oct 1967).

Results of a physical survey of all dental x-ray units in the state of Wisconsin are reported. In the first survey, the x-ray units were checked for proper beam, proper beam filtration, beam strength, electrical grounding, and scatter radiation measurements. The results showed that out of 2369 units surveyed, 1408 or 59.88% of the x-ray units were in compliance with the State Radiation Protection Code. Those that did not meet the requirements of the code in regard to filtration and collimation were changed to come into compliance. During the surveys, it was found that the beams of dental x-ray units ranged, in dia, from 1½ to 6 in. Of the 2369 x-ray units surveyed, 305 or 12.8% were more than the 3-in beam dia maximum. Beam size corrections were made on 504 x-ray units or 21.27% of the units surveyed. The State Code requires that, for dental x-ray units operating up to 70 kVp, the total filtration permanently in the useful beam shall be equivalent to at least 1.5 mm of Al, and above 70 kVp, at least 2.5 mm. Of the 2369 dental x-ray units surveyed, 803 or 33.89% were incorrectly filtered. Additional Al filters were added to these x-ray units to bring them up to the total filtration required by the State Radiation Protection Code. Stray radiation measurements were also taken at various locations in each dental office to determine dose rates. At present, film badges are being distributed to personnel in each dentist's office to measure more accurately the amount of stray radiation received by each individual in that office. (BBB)

32013 ABSORBED DOSE AND DOSE EQUIVALENT FROM HIGH-ENERGY (≤300 MeV) NEUTRONS AND PROTONS. Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.); Armstrong, T. W.; Coleman, W. A. Trans. Amer. Nucl. Soc.; 13: 412(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32014 MICRODOSIMETRY WITH 14-MeV NEUTRONS. Heintz, P. H.; Robkin, M. A.; Wootton, P.; Bichsel, H. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 13: 432-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32015 ^{252}Cf VS ^{226}Ra DOSIMETRY. Alvi, Zahoor M. (Kaiser Medical Center, Los Angeles). Trans. Amer. Nucl. Soc.; 13: 435-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32016 PRELIMINARY EVALUATION OF ABSORBED DOSE IN MAMMOGRAPY. SIX VIEWS. Palmer, R. C.; Egan, R. L.; Barrett, B. J. (Emory Univ. School of Medicine, Atlanta). Radiology; 95: 395-7(May 1970).

Absorbed doses of x radiation were measured in rads (tissue) in 10 females undergoing mammography by the Egan technique. The patients were selected at random, and no attempt was made to correlate the data with breast type. To compare these data with those of Gilbertson, the latter must first be converted from exposure in air (R) to absorbed dose in tissue (rads) by multiplying by 0.92 rads (tissue)/R for the energies used in the technique proposed by Egan. When this conversion is made, the two sets of data agree within the statistical limits of the experiments. (auth)

32017 EVALUATION OF ROENTGEN EXPOSURE IN MAMMOGRAPHY. PART I. SIX VIEWS. Gilbertson, James D.; Randall, Mitchell G.; Fingerhut, Aaron G. (Los Angeles County Harbor General Hospital, Torrance, Calif.). Radiology; 95: 383-94(May 1970).

The x radiation dose was measured for various body regions in 100 females undergoing mammography by the Egan technique. In addition, 40 studies were carried out on the modified Alderson–Rando phantom. Patients and phantoms were divided into four categories according to breast size. In the first group of patients an inherent tube filtration of 0.4 mm Al was used; 0.38 Al was added in examining the second group. The measurements ranged from background in vagina and left foot dorsum to 25 R (Group 1) and 18 R (Group 2) on the surface of the inner breast. (auth)

Radiation Protection

Refer also to abstracts 31545, 31550, 31552, 31553, 31560, 31564, 31567, 31597, 31649, 31653–31655, 31657, 31661, 31665, 31756, and 32883.

32018 (NP-18204) ASSESSMENT OF INDIVIDUAL RISK DURING ATMOSPHERIC CONTAMINATION BY PLUTONIUM. Pomarola, J.; Risselin, A.; Feliers, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 15 Aug 1966. 8p. (In French). Dep. CFSTI (U. S. Sales Only).

The advantages and disadvantages of the aerosol sampling device and individualized sampling devices are outlined to indicate the need for a more optimum method of measuring individual exposure from plutonium-contaminated air. The compromise solution consisted of a ventilator with an output of 40 to 50 m^3/hr in a channel placed in the upper part of the laboratory, with 20 recording points fitted with flexible channels with sampling heads. The results of one-year's service of this device, during which 20 radioactive aerosol dispersions of ^{235}U or ^{239}Pu were made, showed that the multiple sampling heads gave a picture of the heterogeneity of the contamination. The maximum deviation during these tests corresponded to a factor of 22 and the mean deviation to a factor of 6. Six actual incidents in the metallurgy laboratory confirmed the test results. (J.S.R.)

32019 (SZS-3/70) RADIATION PROTECTION SITUATION IN CONTACT THERAPY. PART I. CRITERIA FOR THE EVALUATION OF RADIATION PROTECTION SITUATION AND THE EFFECTS OF RADIOPROTECTIVE AGENTS IN CONTACT THERAPY. Makedanz, A. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Mar 1970. 38p. (In German). Dep. CFSTI (U. S. Sales Only).

Criterions for the evaluation of the radiation protection situation and the effectiveness of radiation protection means in contact therapy are presented. It is proposed to use the indices radiation burden quotient and radiation protection index. For special investigations more detailed indices are suggested. The index radiation burden quotient was used by 31 clinics. It was found that the maximum factor by which radiation burdens differed was 7 and that the radiation burden quotient is not always lowest where the radiation protection equipment is the best. Data are tabulated on the radiation dose to tissue using ^{226}Ra, ^{60}Co, ^{137}Cs, ^{192}Ir, ^{198}Au, or ^{131}I as the radiation source for contact therapy. (C.H.)

32020 PROBLEMS ABOUT THE LAW CONCERNING PREVENTION FROM RADIATION HAZARDS DUE TO RADIOISOTOPES. Fujii, Seiichi (Shibaura Inst. of Tech., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 491(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Japanese laws concerning the protection of the population against radiation hazards associated with industrial and medical uses of radioisotopes are reviewed. Proposed revisions of the laws are discussed. (C.H.)

32021 SCIENCE AND PRACTICE HAND IN HAND. ADVANCES IN RADIOLOGY, RADIATION PROTECTION, AND BASIC RESEARCH IN THE LIGHT OF THE NUREMBERG LECTURES AND DISCUSSIONS. Kimmel, Karlheinz. Zahnaerztl. Mitt.; 56: 1119-22(1 Dec 1966). (In German).

The present status of procedures used for radiation protection

in dental science and practice was discussed briefly. The review considered effects of x irradiation on dental structures and their growth, embryonal dental development, uses of x rays in dentistry, treatment of osteoradionecrosis, radiation quality, absorption, film, equipment, forensic dental x-ray considerations, results of experimental animal irradiation studies, effects of x irradiation on dental structures and function in infants and small children, effects of irradiation on normal and malignant cells, proper placement of radiation equipment in dental installations, protection of patients and dental personnel during x-ray studies, protection of gonads during dental irradiation procedures, and electron microscope studies of irradiated dental structures. (BBB)

32022 TELEVISION RECEIVERS AND IONIZING RADIATIONS. PROTECTION OF TELEVIEWERS AND MANUFACTURING PERSONNEL. Penotet, M. Arch. Mal. Prof. Med. Trav. Secur. Sociale; 30: 139-42(Mar 1969). (In French).

When the operating voltage of a television set attains or exceeds 20 kV, x-ray emission reaches a dangerous level. In fact this occurs only with color television where the voltage may reach 25 kV and even 50 kV during testing, in which case radiation may attain 20 mR/h (permissible limit 0.5 mR/h). Precautions are indicated for the protection of televiewers and, more especially, workers employed in the manufacture of component parts (television picture tubes, rectified tubes); substitution of lead glass for lime glass; use of metallic or lead glass screens limiting radiation to 0.1 mR/h; use of special screens limiting radiation to 0.1 mR/h at certain manufacturing stages and during adjustments or repairs carried out without other protection; film badges to be worn by personnel, who undergo six-monthly hematological examinations; and testing of apparatus for radiation in ionization chambers. Adoption of all these measures eliminates measurable radiation during the manufacture or use of receivers. (Occup. Safety and Health Abstr.)

Safety Procedures

Refer also to abstracts 31544, 31563, and 31662.

32023 (BRH/DEP-70-6) LABORATORY TESTING AND EVALUATION OF COLOR TELEVISION RECEIVERS ACQUIRED DURING THE IN-PLANT SURVEY. Smith, Thomas M.; Ruggera, Paul S.; Smith, Stephen W. (Bureau of Radiological Health, Rockville, Md.). Apr 1970. 125p. CFSTI.

Under the authority granted to the Secretary, Department of Health, Education, and Welfare by Public Law 90-602, the Radiation Control for Health and Safety Act of 1968, the Division of Electronic Products conducted a field survey of domestic television manufacturers from June 1969 to September 1969 to determine the x ray emitting capability of television receivers manufactured after October 18, 1968. During this survey various receivers, identified as being capable of emitting x radiation, were selected for additional Division of Electronic Products laboratory testing. This report describes the laboratory tests on these receivers, presents the data obtained, and makes recommendations for the reduction or elimination of x radiation emissions. (auth)

32024 (N-70-13526) SPACE RADIATION HAZARDS IN MAN. Annual Report, October 1, 1968-September 30, 1969. Baily, Norman A. (California Univ., La Jolla, San Diego). 30 Sep 1969. 19p. (NASA-CR-66871). CFSTI.

The research program being carried out can be classified in general as: determination of the statistical distribution of the magnitudes of the energy losses by fast charged particles (protons) in tissue-like materials having biologically significant volumes; radiobiological modeling; experimental testing of the radiobiological models as to their capability for predicting radiation damage in human lymphocytes; and development of an electronic system for recording, digitizing, and computer processing of biological indicators of radiation damage or other physiological changes incurred during space flight. All four phases have been given some effort during the past year with the bulk of the effort going into the first phase. Obtained were experimental data to assess the accuracy of available theoretical treatments for all energy losses having an occurrence probability of greater than 0.0001. (auth) (USGRDR)

32025 (N-70-15400) INDUCED RADIONUCLIDES IN ASTRONAUTS. Final Report, June 15, 1967-September 1, 1968. Brodzinski, R. L.; Wogman, N. A.; Perkins, R. W. (Battelle-Northwest Richland, Wash. Pacific Northwest Lab.). 56p. (NASA-CR-107583; BNWL-531-4). CFSTI.

Activity-dose energy relations for ^{7}Be, ^{13}N, ^{22}Na, and ^{24}Na activities induced in unshielded muscle tissue and tissue-equivalent phantoms by bombardment of protons up to 580 MeV were measured, and the relation between radiation dose and induced activity for any given proton-bombarding energy is defined. The determination of the radiation dose received by an astronaut from cosmic radiation of unknown energy by measuring the concentration of the radioactive isotopes induced in his body is discussed. Measurements to define the excretion pattern of induced radionuclides from proton-irradiated patients, and studies of the cosmic-ray dose to high altitude pilots were also continued. (auth) (USGRDR)

32026 EPIDEMIOLOGIC STUDIES OF OCCUPATIONAL DISEASES. Cralley, Lewis J. (Public Health Service, Cincinnati). pp 7-30 of Industrial Hygiene Highlights. Vol. I. /Cralley, Lester V. (ed.). Pittsburgh; Industrial Hygiene Foundation of America, Inc. (1968).

Changes that have taken place in the design of epidemiologic studies of occupational diseases are discussed along with emerging data reported from on-going epidemiologic studies. Emphasis is given to environmental factors relating to occupational diseases. Studies reported include asbestos, benzene, beryllium, cadmium, cement, chrome plating, chlorine, coal, cotton, foundry, graphite, lindane, magnetite, mercury, rubber and cable-making industries, silica-silicates, talc, and uranium. Studies by the United States Public Health Service and the Serbian Institute of Occupational Health in Yugoslavia on the health of uranium miners are mentioned and methods for reducing hazards to miners are discussed. (80 references) (C.O.)

32027 ETIOPATHOGENESIS OF BRONCHOGENIC PULMONAR CARCINOMA IN MINERS FROM URANIUM MINES. Kusak, Vlastimil (Ceskoslovenska Akademie Ved, Prague). Strahlentherapie; 138: 549-55(Nov 1969).

The problem of etiopathogenesis of carcinoma of the airways of uranium miners and its prevention were investigated. On the basis of known properties of molds to absorb into their body radioactive substances from the medium and because of diseases caused by molds of the Aspergillaceae family, a working hypothesis of the etiopathogenesis of airway carcinoma of uranium miners was devised. Simultaneously the possibility of protection against the formation of a focus of ionizing radiation in the lower respiratory tract of these miners was indicated. (auth)

32028 RADIATION AND HEALTH. Mayneord, W. V. Acta Tuberc. Pneumol. Belg., 59: 357-70(Mar.-June 1968).

Mention is made of estimates of the mean levels of ionising radiations to which some human populations are exposed and of the order of magnitude of biological effects to be expected in both somatic and genetic fields. The hazards of ionising radiations are related to other environmental hazards. In peace-time diagnostic radiology is the prime contributor of man-made dose but by simple means this dose could be substantially reduced. The need for responsible decision and technical competence in diagnostic radiology is emphasized, so that its immense benefit may be obtained with least risk. The extreme complexities of industrial control and use of radioactive materials is discussed. (F.M.M.)

Civil Defense

32029 MINIMIZATION OF FATALITIES IN A NUCLEAR ATTACK MODEL. Owen, Guillermo (Hudson Inst., Harmon-on-Hudson, N. Y.). Oper. Res.; 17: 489-505(May-Jun 1969).

A simple model of a nuclear attack is proposed whereby deployment of defenses, subject to a limited budget, would minimize the damage that an enemy attack can cause. One side (the defender) would first deploy its defenses, consisting of both a passive defense (shelters), and an active defense (anti-missile missiles); the other side (the attacker) then would decide how to aim its missiles. The defender is constrained by budget limitations, while the attacker is constrained by the number of missiles available. The payoff is in term of fatalities. The model is based on a convex duality theorem that changes the minimum-maximum problem to a pure minimization problem, and obtains a solution that obeys the no-soft-spot rule. An example shows the effects of attack and budget sizes, as well as of the costs of ABM defense. These results are presented in such a way as to show the fatalities in 20-missile and 200-missile attacks as a function of the budget size. Different curves in the various figures represent different unit costs for ABM systems. (BBB)

Legal Aspects

Refer also to abstracts 31972, 32263, 32285, 32298, 32299, and 32312.

32030 DETERMINING PERMISSIBLE RADIATION DOSES IN PLANNING SPACE FLIGHTS. Davydov, B. I.; Antipov, V. V.; Saksonov, P. P. Kosm. Issled., 6: 450-70(1968). (In Russian).

The following factors were taken as the basis for determining permissible radiation doses for manned space flights: choice of criteria (genetic effects, immediate and remote sequelae, etc.); type of radiation; the mass of irradiated tissue and its radiosensitivity; pharmacological protection; the possibilities of recovery from the effects of ionizing radiation; age of the cosmonaut; flight conditions (length, orbit); purpose of the spaceflight. Since so many factors are involved, obviously it is virtually impossible to establish a single value as a permissible dose under all circumstances; radiation exposure must be evaluated for each flight individually, and the possibility of accidents (e.g., exposure to solar flares) in which permissible doses would be exceeded, must be considered. After a lengthy discussion of genetic and somatic radiation effects, it is concluded that attention should be focused upon short-term effects that would interfere with the performance of the cosmonauts while aloft. Although there is considerable difference of opinion, 25 rad appears to be a good choice for the value of a single permissible dose. (ATD) (TSS)

32031 PROTECTION OF THE PUBLIC IN RELATION TO USE OF RADIOACTIVE MATERIALS. Hughes, C. O. le C. J. Roy. Nav. Med. Serv. (London), 54: 238-44(Winter 1968).

A review of measures taken to protect the general public by the Navy Department is presented. An explanation of the general relationship of the Department to other Government Departments with Statutory powers and the general organisation for radiation safety are given. Some specific problems are described together with the means by which the necessary control is imposed to solve them should any particular incidents or accidents occur. (auth)

32032 RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ADOPTED SEPTEMBER 17, 1965). ICRP Publication 9. New York; Pergamon Press (1966). 31p. $1.75; 10s.

The position of the ICRP is reported and is intended to be a complete and comprehensive account of its basic principles. The material is presented in four major sections: the basic principles underlying the recommendations of ICRP (includes objectives of radiation protection, dose equivalent, dose rates, critical tissues, risk concepts, exposure categories, and sources of exposure); limitation of doses for exposures from controllable sources (includes individual exposures and population exposures); action levels for exposures from uncontrolled sources (such as accidents); and general principles for operational radiation protection. The work and organization of the Commission are outlined and a list of previous publications of the Commission is provided. (C.O.)

32033 CONSIDERATIONS ABOUT DISEASE-ACCIDENT FROM IONIZING RADIATIONS. Strambi, E. (CNEN, Rome). Lav. Umano; 19: Suppl. No. 12, 82-93(1967). (In Italian). (RT/PROT-(69)2).

Analysis of common law about accidents and examination of the special rules relating to the peaceful use of the nuclear energy are used to outline the fundamental analogies and some differences between the concept of accident and that of nuclear accident. Particularly interesting, in this respect, is the comparison of the trends followed by the principal European countries, members of the OCDE, and signatories of the Convention of Paris of July 29, 1960, in the respective legal regulations concerning the damages caused by the mentioned nuclear activities. Insurance coverage for disease-accident situations is discussed. Some ambiguity of interpretation deriving from the present orientation of the Insurance Institutes is pointed out and it is suggested, in the practical field, that some levels could be temporarily adopted as a precautionary notice to the insurer of an accident only potentially dangerous but without clinical signs of damage to the persons. (C.O.)

32034 LASER SYSTEMS: CODE OF PRACTICE (1969). Orpington, Eng.; Safety Services Organization, Ministry of Technology (1969). 64p.

This revised code is a practical guide to the evaluation of hazards that can arise when working with lasers. Maximum permissible exposure levels and rules for safe working procedures in laser installations are given. (UK)

Medicine

Refer also to abstracts 31285, 31363, and 31593.

Protective Substances

Refer also to abstracts 31843, 31920, 31951, 32143, 32179, 32215, 32221, 32235, 32240, and 32280.

32035 EFFECTS OF OXYGEN ON IRRADIATED SOLID EGG-WHITE LYSOZYME. Stevens, Clarence O.; Tolbert, Bert M.; Bergstrom, Glenn R. (Fitzsimons General Hospital, Denver. Univ. of Colorado, Boulder). Contract AT(11-1)-690. Radiat. Res.; 42: 232-43(May 1970).

Chromatographically homogeneous egg-white lysozyme was subjected to gamma radiation in vacuo and in the presence of oxygen. Soluble active and inactive fractions from these samples were isolated by salt precipitation and chromatographic steps. Specific enzymic activity and molecular weight measurements indicated that both aggregation and destruction of essential structural features accompany and may be the mode of radiation inactivation. The presence of oxygen enhances both possible inactivation modes. Exposure of samples to oxygen following irradiation in vacuo does enhance radiosensitivity, but the mode of inactivation favored by such treatment is not clear. (auth)

32036 EXPERIMENTAL STUDY ON TUMOR CELL PROLIFERATION AND THE RETICULOENDOTHELIAL SYSTEM, WITH SPECIAL REFERENCE TO ACCELERATION OF PROLIFERATION FOLLOWING ^{60}Co WHOLE-BODY IRRADIATION. Tanaka, Takashi (Fukushima Medical Coll., Japan). Proc. Jap. Soc. Reticuloendothel. Syst.; 8: 315-25(Mar 1969). (In Japanese).

The role of the reticuloendothelial system in the host resistance to the proliferation of tumor cells was studied in rats with experimental liver neoplasm and exposed to total-body irradiation with ^{60}Co at the dose of 500 R. Marked degeneration of subcutaneous tissue cells and intraperitoneal cells was observed immediately following irradiation. The number of intraperitoneal cells also decreased rapidly and did not resume pre-irradiation state within one week. Host resistance decreased in proportion to the decrease in the number of intraperitoneal cells, showing its close association with the reticuloendothelial system. Intraperitoneal injection of zymosan-treated cells resulted in marked inhibition of tumor growth, recovery from disorders due to ^{60}Co irradiation, and the subsequent prolongation of survival. It was suggested that the antineoplastic effect of zymosan is indirect and that the reticuloendothelial system is directly associated with the host defense mechanism. (NSA of Japan)

32037 INDIRECT RADIOPROTECTION BY SULFHYDRYL COMPOUNDS: A MODEL CHEMICAL SYSTEM. Loman, H.; Voogd, S.; Blok, Joh. (Free Univ., Amsterdam). Radiat. Res.; 42: 437-45(Jun 1970).

It is shown that radicals produced from ethanol, formate, and methanol by OH radical attack are able to destroy the thymine chromophore, with a rate constant of the order of 10^5 M^{-1} sec^{-1}. Addition of small quantities of cysteine protects thymine almost completely. This is explained by H-atom transfer from the sulfhydryl compound to the organic radical thus restoring the parent organic molecule and preventing the reaction of the organic radical with thymine. It is suggested that this type of indirect protection of a DNA constituent may be of importance for the radioprotection of DNA in living cells. (auth)

32038 PROTECTIVE EFFECT OF CYSTEAMINE ON THE TERATOGENIC ACTION OF X-RAYS IN GOLDEN HAMSTER. Kulig, A.; Kowalczyk, K.; Pionkowa, I. (Jagellonian Univ., Krakow). Pol. Med. J.; 8: 902-8(1969).

The effect of x radiation on golden hamster fetuses and the protection afforded by cysteamine were studied. Doses of 70 R and 100 mg of cysteamine per kg body weight were used. Under the influence of radiation, the fetuses showed development anomalies of the eyeball and/or died. Cysteamine gave a certain protection from radiation injury but it was probably also harmful to the fetuses. (auth)

32039 EFFECT OF A MIXTURE OF CHEMICAL PROTECTORS AGAINST X-IRRADIATION INDUCED TESTIS INJURY IN MICE. Leonard, Alain; Maisin, Jean Rene; Mattelin, Gilbert (Nuclear Energy Study Center, Mol, Belgium). Strahlentherapie; 138: 614-18(Nov 1969).

The effect of a mixture of chemical radioprotectors has been studied on x-irradiated testes with cytological techniques. Male mice from the BALB/c strain were given a mixture of GSH (glutathione), cysteine, MEA (mercaptoethylamine), AET (2-β-aminoethylisothiouronium-Br-HBr) and 5-HT (5-hydroxytryptamine). Half of the animals received 1350 R of local x irradiation. Five mice of each treatment (control, control given mixture, irradiated and irradiated given mixture) were killed at different intervals after treatment. Treatment with the mixture of chemical protectors before x irradiation was found to delay the disappearance of the male germ-cells and to accelerate the regeneration of the seminiferous epithelium. These results show conclusively that a combined treatment with different chemical protectors increases

the protection obtained from each compound given separately. (auth)

32040 POTENTIAL ANTIRADIATION AGENTS. II. GUANIDINOALKANETHIOSULFURIC ACIDS. Klayman, Daniel L.; Grenan, Marie M.; Jacobus, David P. (Walter Reed Army Inst. of Research, Washington, D. C.). J. Med. Chem., 12: 723-5 (July 1969).

Reported here are the synthesis and the antiradiation activity of 2-guanidinoethanethiosulfuric acid (I) and six variants of its structure in which the carbon skeleton consists of two, three, or four CH_2 groups and in which some of the guanidino groups are alkyl substituted. The method of preparation consisted of heating a solution of an S-methyl derivative of a thiopseudourea with the Na salt of an aminoalkanethiosulfuric acid. When methyl mercaptan, a by-product of the reaction, was no longer evolved, the reaction mixture was concentrated and cooled to give the guanidinoalkanethiosulfuric acid. Antiradiation properties were tested for the drugs, freshly prepared as neutral solutions or suspensions, administered intraperitoneally 15 to 30 min before exposure to lethal whole-body irradiation. Mice were given a dose of 1000 R in a specially designed ^{60}Co irradiator at a dose rate of 45 to 48 R/min. Mortality was recorded daily over a 30-day observation period. Of the guanidinoalkanethiosulfuric acids studied, only I showed radioprotective activity comparable to that afforded by MEA. A comparison of the radioprotective activities of aminoalkanethiosulfuric acids with the corresponding substituted or unsubstituted guanidinoalkanethiosulfuric acids revealed that superior activity is obtained if the guanidino group is unsubstituted. Diminished activity results, however, if the guanidino moieties are alkyl-substituted. As was the case with aminoalkanethiosulfuric acids, optimal effectiveness is found in guanidinoalkanethiosulfuric acids when the N and S functions are separated by two carbon atoms. (BBB)

32041 EFFECT OF CHEMICAL RADIOPROTECTIVE AGENTS ON DELAYED RADIOLESIONS AND RADIOCARCINOGENESIS. Duplan, J. F.; Maldague, P. (Institut du Radium, Paris). Rev. Med. Liege; 23: Suppl. No. 1, 139-44(Oct 1968). (In French).

The general effects of radioprotective agents on delayed irradiation injuries and radioinduced tumors were discussed. The three types of late injuries produced by irradiation were considered to be early senescence manifested by early appearance of symptoms of old age, increase in numbers of tumors at earlier age, and life shortening by increased mortality from cancers. Studies of the occurrence and characteristics of renal tumors in the rat and lymphoid leukemia in mice indicated that the percent of malignant and benign renal tumors induced by x irradiation increased markedly above doses of 850 R, and reached 80% at doses of 1710 R. The incidence decreased sharply at doses above this. If mercaptoethylamine was given before irradiation, a dose reduction factor of 1.5 to 1.8 was obtained. At a dose of 2850 R the number of malignant tumors induced in the protected group increased to the level found in the unprotected group given 1710 R. However, the number of malignant tumors at 1710 R was increased in the protected group as compared to the unprotected group given a dose of 1140 R. Similar results were obtained for the numbers of benign renal tumors induced by x irradiation. Radioprotection with mercaptoethylamine had little effect on survival of rats following x irradiation of kidney with doses of 2850 R to the kidney. A dose reduction factor of about 1.3 was obtained in mice x irradiated with doses of up to 800 R who developed lymphoid leukemias. The lethal effects produced in radioinduced tumors and the mechanisms of stimulus of regeneration were discussed. The factors discussed included effects of fractionated irradiation on tissue regeneration, effects of hormonal imbalance on tumorigenesis, and inhibition of stimulation in the leukemogenic process. Possible bases for the differences in the dose reduction factors observed for the radioinduced renal tumors and leukemias studied were discussed. (BBB)

32042 REMARKS ON RESULTS OBTAINED DURING A STUDY OF VARIOUS RADIOPROTECTIVE AGENTS AND A RADIOSENSITIZING AGENT. Rinaldi, R. (CENG, Grenoble, France). Rev. Med. Liege; 23: Suppl. No. 1, 166-73(Oct 1968). (In French).

The radiation protection and sensitization properties in mice of various imidazole compounds, such as methyl-2-imidazole, methyl-1-thio-2-imidazole, hydroxymethyl-4-imidazole, thio-2-imidazole, diphenyl-4,5-imidazole, dimethyl-4,5-imidazole dicarboxylate, carboxylic acid-4-imidazole, dicarboxylic-4,5-imidazole, and acetic acid-4-imidazole were studied. These agents were administered intraperitoneally in doses of 0.08 to 2 mg/g body wt, corresponding to the LD_{50} dose, 5 min prior to x irradiation with doses from 700 to 1000 R. Survival of the mice ranged from 0 to 90%. Imidazole gave 70% survival under these conditions, but it gave only 20% survival if given 1 hr before irradiation. Substitution of methyl, phenyl, carboxyl, acetyl, hydroxyl, and sulfhydryl groups resulted in little or no radioprotection. Naphthyl-1-methyl-2-imidazoline gave 45% survival in male mice and 75% survival in females. In sodium merthiolate solution it gave 98% protection in male mice. In male mice 2(4-butyl-2-6-dimethylphenylmethyl)imidazoline HCl in sodium merthiolate gave 70% protection. Thio-2-imidazoline gave 26% protection in females, but none at all in males. Out of 8 azines and diazines, only pyridine benzimidazole gave 90% protection when administered at the LD_{50} level, and 100% protection at the most toxic level. At the LD_{50} level 2-methyl benzimidazole gave 60% protection. When the NH_2 radical was located at position 2 and 5, radioprotective properties decreased considerably. At the LD_{50} dose level, azo-4-benzimidazole was inactive, but at lower dosage it gave 20% protection. Purines and hydrazine were inactive, but phenylhydrazine gave 33% protection in male mice, and 12% in females. Radiosensitivity of mice given the Na salt of cyclohexyl succinate was unaffected, as compared to control mice. In general, the chemicals tested were most effective at the more lethal dosages. (BBB)

32043 COMBINATION OF RADIOPROTECTIVE AGENTS AND 5-HYDROXYTRYPTAMINE. Maisin, J. R.; Lambiet-Collier, M.; Mattelin, G. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Rev. Med. Liege; 23: Suppl. No. 1, 144-51(Oct 1968). (In French).

Radiation protection effects of combined treatment with sulfhydryl compounds and 5-hydroxytryptamine (5-HT), which produces anoxia, were studied. These effects were studied by measuring short- and long-term survival of mice, protection against x-irradiation injuries of the intestine and bone marrow, and mechanisms of action of combination treatments. The chemicals studied included 2-β-aminoethylisothiourea (AET), glutathione (GSH), 5-HT, mercaptoethylamine (MEA), and cysteine. They were given orally or intraperitoneally in doses of from 1 to 16 mg. The animals were irradiated with doses of more than 2000 R, given over periods of 12 to 16 weeks. An additional treatment used was intravenous injection of 10^8 isologous bone marrow cells. The results indicated that the effects of combined use of radiation protection agents were greater than the sum of each used alone. This effect was greatest with the more effective agents, and suggested that their mechanisms of action differed. Irradiation injuries of the intestine and bone marrow after irradiation doses of 2000 R were decreased by treatment with the radiation protection chemicals. Long-term survival of mice irradiated with doses of 700 R was increased by various combinations of the radiation protection agents. Animals that were exposed to 2000 R of irradiation and survived at least 30 days subsequently died during the period from 30 to 180 days after irradiation, with evidence of pulmonary edema and congestion. Some biochemical mechanisms that were possibly responsible for the protective actions of the chemical combinations used were discussed. The additive effects observed suggested ways that various combinations of the chemicals could be used to enhance their radiation protection qualities. (BBB)

32044 LOCAL PROTECTIVE EFFECT OF POTASSIUM CHLORIDE ON THE DEPILATORY ACTION OF X-RAYS IN YOUNG MICE. Pospisil, M.; Ptacek, Vl. (Inst. of Biophysics, Brno). Experientia; 26: 299-300(15 Mar 1970).

A whole-body dose of 550 R x radiation was administered to 8-day old mice; eight days after a complete depilation was observed in control mice. Experimental mice were given subcutaneous injections of isotonic solutions of sodium chloride or potassium chloride shortly before or after irradiation. Results indicated that potassium chloride injected shortly before irradiation gave a high degree of protection. It was found that potassium chloride induced a marked drop in oxygen tension in the subcutaneous tissue; it is suggested that the local hypoxic state may be responsible for the protective effect of potassium chloride. (H.L.W.)

32045 SOME HETEROCYCLIC NITROGENOUS COMPOUNDS AS RADIOPROTECTANTS FOR HAEMATOLOGICAL LEVELS IN X-IRRADIATED MICE. Roushdy, H. M.; Pierotti, T.; Polverelli, M. (CEN, Grenoble, France). Z. Naturforsch.; 25b: 80-7(Jan 1970).

In normal controls, the levels of hemoglobin concentration and hematocrit values remained almost unchanged throughout the experimentation period. Intraperitoneal administration of imidazole and benzimidazole affected rapid pharmacodynamic incidences that were not detected with cysteamine. Administration of imidazole did not induce detectable change in the level of hemoglobin concentration but slightly decreased the hematocrit value. Benz-

imidazole created slight depression in hemoglobin concentration and exerted no effect on hematocrit value. Cysteamine caused slight depression of both hemoglobin concentration and hematocrit value. Those changes were readily restorable with imidazole and benzimidazole while those with cysteamine lasted for more than three days. Irradiation caused progressive decrease in hemoglobin concentration and hematocrit values that continued till the death of the animals. A significant increase in the sedimentation rate of red blood cells was recorded. Irradiation of chemically protected animals caused initial decrease in hemoglobin concentration and hematocrit values that lasted till the fifth post-exposure day. Later, gradual restoration of normal levels of hematological values was recorded. Restoration was more rapid with benzimidazole than with imidazole, while cysteamine was half way in its action. The increase in sedimentation rate of red blood cells was less pronounced and gradual restoration of the normal sedimentation rate was maintained during the post-irradiation time. It seems likely that the radioprotectants act on cellular and subcellular levels in the protected tissues but the actual role played by such compounds still awaits further investigation. Imidazole and benzimidazole proved to be effective radioprotectants of the hematopoietic tissue. Benzimidazole proved to exert the best radioprotective characters amongst the tested compounds. (auth)

32046 CONTRIBUTION TO THE STUDY OF THE PROTECTION OF DOMESTIC RABBIT FROM COMPLETE IRRADIATION BY GAMMA RAYS. Rico, A. G.; Lorgue, G. Rev. Med. Vet.; 121: 119-25(1970). (In French).

A radioprotective effect of highly polymerized DNA was demonstrated in rabbits given whole-body γ radiation. The death rate was 13 per 100 in the treated group as compared with 60 per 100 in the controls. Recovery was more rapid in the treated animals and the blood cell count returned to normal more quickly. (auth)

Radiation Sickness and Injuries

Refer also to abstract 32264.

32047 RADIODERMATITIS AND RADIONECROSIS OF THE MAMMARY REGION. Damiani, Roberto (Univ., Milan). Bull. Sci. Med., 139: 16-39(Jan.-Mar. 1967). (In Italian).

Mammary radiodermatoses and necroses are important because in case of cancer of the mammary gland its surgical removal is now routinely followed by massive and penetrating irradiation of the mammary region to clear out residual malignancies that may produce recidivism and metastases. Lighter irradiations often produce dermatoses in the form of irregular pigmentation and sclerotic indurations covered with white mottled crusts. In case of stronger irradiation the lesions assume necrotic aspects: ulceration of the thoracic region, extensive tissue destruction deep into the subcutaneous region; bone and muscle destruction. If the affected bone tissue is no longer protected by skin and cartilage, infections occur that can lead to either necrosis of the spongal bone tissue or in case of penetration of the thoracic wall to pneumothorax. Ulcerations are often connected with infections and exudations and a rapid deterioration of the patient's general condition. The affected tissues must be completely removed and restored by grafting of healthy tissue. The complexity and great variety of the lesions requires specific methods of surgical reconstruction adapted to the individual case and the greatest skill of the surgeon. If heart or pericardium was affected by radiation, greatest caution is imperative, particularly in anesthesia, lest heart standstill occur. In case of non-ulcerated dermatoses, a skin graft is not difficult and usually well taken. However, when substantial parts of the body must be removed, a previously removed and properly prepared skin graft must be made. When the thoracic wall has been broken and lungs and pericardium exposed, only healthy and adequately vasculated tissue is allowed to remain, in which case the reconstruction is a difficult task. In many instances it is possible to use for it the opposite breast. If the latter should be inadequate, it is often possible to cover by means of rotation the area in need of reconstruction. If even this technique is not feasible in view of the size of lost substance, one may as a last resort use a suitable skin flap from the abdomen and graft it onto the cleared out-area. (F.J.W.)

32048 X-RAY SURVIVAL OF CULTURED CHINESE HAMSTER CELLS RESUMING GROWTH AFTER PLATEAU PHASE. Chapman, J. D.; Todd, Paul; Sturrock, Jean (Mount Vernon Hospital, Middlesex, Eng.). Radiat. Res.; 42: 590-600(Jun 1970).

Populations of Chinese hamster cells (line V79-379-A) were harvested from monolayer cultures in which net cell multiplication had ceased. Survival based on colony formation following exposure to 250 kV x-rays was studied in cells harvested from 90- and 135-hour-old monolayers. In populations of cells resuming growth after harvesting from 90-hour monolayers, a peak of radiation resistance was observed during growth-resumption G_1 phase and again during late S phase. Cells harvested from 135-hour monolayers had a longer cell cycle but no wave of radiation resistance during the greatly prolonged growth-resumption G_1 phase. The increased resistance during growth-resumption S phase was found to be related to increased extrapolation numbers of the survival curves, and recovery from sublethal injury occurred in growth-resumption S cells. Cell populations harvested from 135-hour-old monolayers regained their ability to recover from sublethal injury within two hours. (auth)

32049 EFFECT OF ETONIUM ON REDOX PROCESSES IN RADIATION ULCERS OF THE SKIN. Moldovan, V. I.; Pis'ko, G. T. (Central Research Inst. of Roentgen-Radiology, Moscow). Med. Radiol.; 15: No. 3, 49-52(Mar 1970). (In Russian).

Experiments were made on 55 guinea pigs to study the influence of a new preparation, etonium, on such indexes as endogenic dehydrogenase activity and the level of sulfhydryl groups in the skin tissues in the local action of ionizing radiation. Experiments showed that in radiation injuries of skin tissues of guinea pigs, the endogenic dehydrogenase activity and level of SH-groups sharply declined. In etonium treatment of radiation injuries of the skin there occurred a restoration of the referred-to indexes of redox processes in the tissues, testifying to the stimulating effect of the preparation on tissue regeneration. (auth)

32050 DEFECT GRAFTING FOLLOWING DAMAGE TO THE SKIN AND SURROUNDINGS IN THE FACIO-CERVICAL AREA. Roggendorf, E. (Univ., Berlin). Chirug; 40: 70-6(Feb 1969). (In German).

As a result of a review of 100 surgical treatments of skin defects in pre-injured tissues some important problems of reconstructive surgery in the face and neck area are discussed. In the face and neck area the available measures of treatment of pre-injured skin defects must be carefully selected for each case because in these regions functional as well as cosmetic factors have to be regarded. Corresponding to the kind of pre-injury the following groups could be treated as a whole: scars consequent of mechanical damages or chronic inflammations, states in consequence of burns and chemical damage, damages in consequence of radiotherapy and combined injuries. Intensity and localization of each pre-injury were taken into consideration. The therapeutical consequences resulting from these considerations are described. (auth)

Radiodiagnosis

Refer also to abstracts 31324, 31364, 31419, 31676, 31693–31701, 31703, 31705, 31719, 31757, 31764, 31766, 31772, 31784, 31785, 31798, 31801, 31980, 32001, 32021, and 33078.

32051 (CNEA-259) COMPOUNDS OF ^{113m}In FOR HEPATIC SCINTILLOGRAPHY AND STUDIES OF THE CIRCULATORY SYSTEM. Ciscato, V. A.; Nicolini, J. O.; Palcos, M. C.; de Piccinni, Z. F. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1969. 18p. (In Spanish). Dep. CFSTI (U. S. Sales Only).

A simple method is described for the preparation of ^{113m}In-labeled pyrrolidone vinyl polymers with colloidal properties using ^{113m}In obtained from a ^{113}Sn–^{113m}In generator. A method for the preparation of ^{113m}In-labeled albumin is also described. Injections of both compounds gave good results when used for scanning blood circulation in the liver and heart, for measurements of blood volume, and for placental scanning. (C.H.)

32052 (COO-78-215) ANALOG TECHNIQUES FOR PROCESSING IMAGE DATA. Gregg, E. C. (Case-Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology). [1969]. Contract W-31-109-eng-78. 17p. (CONF-700516-1). Dep. CFSTI.

From 1st Biennial Conference on Quantitative Organ Visualization in Nuclear Medicine, Miami, Fla.

Analog computer techniques for processing radioisotope scan data are discussed. It is pointed out that, while an analog computer is inherently a one dimensional system, it is possible to perform two dimensional isotropic operations such as filtering; aperture correction; profiling; and contour enhancement. An overall accuracy of 0.01% is attainable in most of the analog mathematical manipulations and computing times on the order of nanoseconds may be achieved. (C.H.)

32053 (COO-78-218) INFORMATION STORAGE AND DATA MANIPULATION IN SCINTISCANNING. Friedell, H. L.; Rejali, A.; Gregg, E. C. (Case-Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology). [1969]. Contract W-31-109-eng-78. 6p. (CONF-690953-1). Dep. CFSTI.

From International Meeting on the Use of Computers in Radiology, Brussels, Belgium.

An analog-digital computer system for the storage and manipulation of radioisotope scan data is described. The system can be used with either a scintillation camera or mechanical scanner. The final record is digital and independent of the characteristics of the recording device. Permanent time records of the sequence of uptake, dilution, and clearance of radioisotopes or labeled compounds are available for viewing with only about five minutes time required between the finished scan and final record. (C.H.)

32054 (COO-78-225) VISUAL RESPONSE OF THE INTERPRETER. Gregg, E. C. (Case-Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology). [1969]. 19p. (CONF-700516-2). Dep. CFSTI.

From 1st Biennial Conference on Quantitative Organ Visualization in Nuclear Medicine, Miami, Fla.

The factors influencing visual perception by the human eye are discussed in relation to the perception of abnormalities in radiographs and radioisotope scans examined visually. Optical manipulations to improve contrast enhancement during visual presentations are discussed. (C.H.)

32055 (IAN-B-3) METHODS FROM THE FIELD OF NUCLEAR MEDICINE INCLUDING PROGRAMMES FOR A SMALL DESK-TOP COMPUTER. Kutka, M.; Posada, J. R.; de Betancourt, I. L. (Instituto de Asuntos Nucleares, Bogota (Colombia). Seccion de Medicina y Biologia). 1969. 279p. Dep. CFSTI (U. S. Sales Only).

The advantages of using a small desk-top computer for calculations for radioisotope kinetic studies used for medical diagnosis are discussed. A collection of computer programs developed for use in a nuclear medicine laboratory is included. Programs are included for use for correction of counting data for radioactive decay; for measuring the components of a mixture of two radioisotopes with different half lives; for computing the radiation dose to source and target organs or tissues from data on radioactivity of the administered radioisotope; and for comparison of results of statistical analyses of counting data. (C.H.)

32056 (NP-18098) NUCLEAR MEDICINE. Winston Churchill Memorial Trust (Australia) Fellowship Report No. 7. Ronai, Peter Michael (Institute of Medical and Veterinary Science, Adelaide (Australia)). Sep 1969. 37p. Dep. CFSTI (U. S. Sales Only).

An account is given of a study tour in January through March 1968 of 10 major Nuclear Medicine laboratories in U.S.A. and Canada. Advances in instrumentation, data processing and radiopharmaceuticals are discussed. The methods of preparing ^{99m}Tc-labeled albumin and albumin aggregates and ^{113m}In-labeled pharmaceuticals are described. The staffing and equipping of nuclear medicine laboratories is discussed. (Australia)

32057 (NP-18185) ACTIVITIES INVESTIGATED IN 1968. (Sao Paulo Univ. (Brazil). Centro de Medicina Nuclear). 114p. (In Portuguese). Dep. CFSTI (U. S. Sales Only).

The Center of Nuclear Medicine, connected with the Faculty of Medicine of the University of São Paulo, Brazil, concentrates all types of medical and biological applications of radioisotopes, and works in collaboration with all Departments of the Faculty of Medicine, the Clinical Hospital and other University Institutes according to request. The Division of Training and Biological Research is responsible for basic research with radioisotopes in different fields of biological and biochemical applications, organizes post-graduate courses in tracer methodology and application of radioisotopes in biological research, and is responsible for the general organization of courses given by the other Divisions. The Division of Radiobiology is engaged in research on the biological effects of radiation, especially related to mammals and the man, and organizes courses on the biological effects of radiation. The Division of Medical Research applies radioisotopes in diagnosis and therapy in cooperation with different medical schools and university hospitals, and gives a course on specialization in nuclear medicine. The Division of Physics and Radiation Hygiene is responsible for the radiological health survey of the staff members who work with radioisotopes and the general survey of the building, and also supervises all research with regard to radiation dosimetry, and gives a course on radiation hygiene and radiological protection. (C.H.)

32058 (NP-tr-1876) PROBLEMS OF INTERPRETATION OF ISOTOPE SCANS OF THE NORMAL AND PATHOLOGICAL PANCREAS. Centi Colella, A.; Pigorini, F. Translated by L. Wittels (Atomic Energy Research Establishment, Harwell, Eng.), from pp 121-54 of XXIII Congresso Nazionale di Radiologia e Medicina Nucleare, Padua, May 5-8, 1968. 43p. (CONF-680562-1). Dep. CFSTI (U. S. Sales Only).

The use of ^{75}Se-selenomethionine for pancreas scanning is discussed. Methods for the preparation of high specific activity ^{75}Se-selenomethione and the dietary and pharmacological preparation of patients to increase the uptake of the tracer by the pancreas are described. Results are reported for 250 scans of 100 patients, of whom 25 were considered to have a normal pancreas. The clinical symptoms and laboratory findings on 85 patients and surgical findings on 33 patients were correlated with scan data. Results showed that scanning is useful in the diagnosis of pancreatic lesions when used in combination with clinical symptoms and laboratory data. (C.H.)

32059 (ORNL-4558, pp 48) ^{67}Ga LOCALIZATION IN TUMOR TISSUES. Brown, D. H.; Carlton, J. E.; Hayes, R. L.; Martin, T. J.; Candler, E. L. (Oak Ridge National Lab., Tenn.).

Tumors were induced in hamsters by injection of adenovirus 31 and SV40 virus-transformed tumor cells. A definite localization of ^{67}Ga was indicated in the tumors as detected by a whole-body γ-ray scanning detector. A radioactive assay of other tissues indicated a substantially higher level of ^{67}Ga in the tumors. The sensitivity of the method is noted in the whole body scans that reveal that there are less radioactive areas in the tumors. (H.L.W.)

32060 (STI/PUB-203) ROLE OF COMPUTERS IN RADIOTHERAPY. Panel Proceedings Series. Report of a Panel Held in Vienna, 10-14 July 1967. (International Atomic Energy Agency, Vienna (Austria)). Aug. 1968. 219p. (CONF-670736). IAEA: $5.50.

Abstracts were prepared on 16 papers that discuss the use of computers in radiotherapy. A summary report of a panel discussion based on the papers, an abstract of a paper on the impact of computers on the running of a radiotherapy department, a bibliography, a glossary, and information on computer programs are included. (C.H.)

For abstracts of individual papers see: 31986-31997, 32062, 32063, 32116, and 32117.

32061 (TID-3319(Suppl.2)) NUCLEAR MEDICINE. Bibliography from Nuclear Science Abstracts, Volume 23. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Jun 1970. 101p. Dep. CFSTI.

References are presented to 1,183 annotated citations on clinical and experimental radiodiagnosis and radiotherapy selected from Nuclear Science Abstracts (NSA), Vol. 23, 1969. Each entry contains bibliographic data and subject headings with modifying phrases prepared for NSA. The references were identified, selected, organized, and listed by the GENOUT computer program. (C.H.)

32062 COMPUTERS AND PLANNING IN CANCER TREATMENT. Ellis, F. (Churchill Hospital, Oxford). pp 145-61 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

In treating cancer there are various possible methods such as surgery, radiotherapy, hormones, and chemotherapy. Other methods may arise but, in all of them, the amount of treatment and the time-schedule are important and should be recorded in a manner capable of analysis. The limiting factor in radiotherapy is the effect on the normal tissues. Too high a dose may reduce the tumor-lethal effect, possibly owing to the need for normal tissue integrity in immunological processes. The tumor volume, of course, contains some normal tissue. Difficulties are, chiefly, knowing the extent of the tumor volume and knowing the rate of division of the tumor cells. Accuracy of knowledge of the position of the target volume at each treatment is essential, but comparisons can only be computerized by describing methods used, not the excellence of usage. Quantities for computerization can include the dose, dose-rate, time, number of sessions, field size, type of radiation, and R.B.E. Uniformity of recording is essential. Clinical factors include the duration, size, stage, histological type, and grade of the tumors. Uncertainties in present practice include the lack of taking account of tissue contours, tissue heterogeneity, and three-dimensional distribution. Unknowns include the extent of tumor involvement and rate of division of tumor cells, inhomogeneity, integral efficiency, local efficiency, danger, biological effectiveness of treatment, relative tissue and organ tolerances. Results should be capable of quick analysis. Decisions can, then, be made on what is best in respect to methods (timing and amount of the various modalities) and techniques of irradiation. Long-term results should be used as guides in making decisions on apparatus, premises, staff, and on sociological matters such as education, prevention, and occupational causes of cancer. (C.H.)

32063 OPTIMIZATION AS A JOINT RESULT OF PLANNING AND IMPLEMENTATION. Sterling, T. D. (Washington Univ.,

St. Louis). pp 163-7 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

The development of sophisticated three-dimensional calculations and displays of dose distribution has forced us to consider limitations during treatment execution as an important and vital complement of treatment planning. If we assume that we can position and move patient, machine, and beam-shaping materials as we please, relative to one another, we could easily derive treatment strategies which would yield very high doses at the tumor and yet avoid vital tissues such as the spinal cord, some of the important glands, the lungs, etc. In practice the execution of such plans is not possible today because the factors that enter into the treatment are relatively static and permit very little freedom of movement between patient, source, and beam-shaping devices. A system by which the patient, his supports, beam-shapers, as well as the source, can move with respect to each other relatively freely and have their movement controlled by suitable computing machinery, would be ideal. Present-day technology is well able to provide us with such an automated implementation system and most of its components have been worked out in relation to automatic tool and load manipulations and in large-scale military and space projects. (auth)

32064 LIMITS OF SCINTIGRAPHIC VISIBILITY OF HEPATIC NODULES. Del Vecchio, E. (Univ., Naples); Fava, G.; Molese, V.; Verrengia, F. Nunt. Radiol., 34: 667-84(July 1968). (In Italian).

Using a facsimile of the liver filled with ^{198}Au and ovals or spheres to represent cold spots (lesions or nodules) attempts were made to find the loci from which such nodules can or cannot be observed. Accordingly the facsimile (after Rando) was filled with 150 μCi of the isotope, sp. act. 0.1 μCi/g, while the nodules were placed in various positions and seen by an anteroposteriorly or laterally placed scanner. A Nukab scanner with a magnetic memory was used to make a black and white map or a photographic elaboration with various cut-offs; alternatively use was made of a Picker scanner which produced a map in which different levels of radioactivity were represented by different colors. Initially a cylinder (height 10 cm, base diameter 11.7 cm) was filled with the isotope solution, in which the thresholds for observation were 15.8 cc for nodes at the surface, and 21.3 cc 2 cm below the surface. Subsequent experiments with the facsimile were better: a 3 cm diameter nodule, placed centrally and deep in the liver, could just barely be observed. Anything smaller as established by previous experiments, could not be seen. Many photographic reproductions of the scans, as well as a table of results, which gives an indication of the ease or difficulty of observing a nodule in a particular location, are given. (C.O.)

32065 COMMENT: THE DETECTION OF OCCULT METASTATIC CANCER BY RADIOACTIVE BONE SCANS. Rubin, Philip. J. Amer. Med. Ass., 210: 1079-81(10 Nov 1969).

Radioisotope bone scans, using ^{47}Ca or ^{87}Sr, which is better, bring to light a greater number of abnormalities than does any other diagnostic method now in use. Such scans are also of value in determining the effectiveness of treatment; dramatic changes in isotope uptake can be correlated with pain reduction and vertebra healing while changes observed by x ray or serum enzyme studies are too slow or uncertain to be of value here. Total body profile scanning, in which the concentration of the isotope in different segments or levels is determined and correlated with local scans, is a tool to the radiotherapist interested in the extent of bone damage and portal size, as well as an aid in the evaluation of response to treatment. In the future, use of the newer short-lived isotopes, such as ^{87m}Sr (2.8 hr) and ^{18}Fl (1.9 hr), will permit lower dosages and more effective serial studies. (C.O.)

32066 ANALOG COMPUTER AIDED RENOGRAM DIAGNOSIS. Hirakawa, Akina (Kyoto Univ.); Ueyama, Hidemaro; Kuwahara, Michiyoshi. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 382-5(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The use of an analog computer for analysis of scan data to determine the excretion rate of injected ^{131}I-labeled hippuran or Na iothalamate by the kidneys was found to be an aid in the evaluation of kidney function and changes induced by various disease conditions. The method was also used for the evaluation of kidney transplants. A mathematical model of the distribution of the tracer as a function of time was developed for use in simulated studies of excretion rate. (C.H.)

32067 AN ANALYTICAL APPROACH FOR SUDDEN INJECTION PROCESS IN ORGAN CIRCULATION. Iwai, S. (Kyoto Univ); Fujii, M.; Watanabe, M.; Wakisaka, G. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 386-8(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Radioisotope scanning techniques for the measurement of blood circulation in organs using digital computer analysis of scan data are discussed. The use of injected ^{198}Au colloids for scanning blood circulation in the liver is cited as an example. A mathematical model of blood flow dynamics in organs for use in radioisotope tracer studies is described. (C.H.)

32068 APPLICATION OF DIGITAL COMPUTER INTO CLINICAL EVALUATION OF LIVER SCAN. Kojima, Kazuhiko; Suzuki, Yutaka; Hisada, Kin-ichi (Kanazawa Univ., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 395-7(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Liver scans made using ^{198}Au colloids and a scintillation counter were evaluated for effectiveness in the differential diagnosis of liver diseases, based on 2,600 cases. The scan data were analyzed using a digital computer and the findings were correlated with clinical laboratory data. The diagnosis was confirmed by objective findings in over 1,000 of the cases. The findings used for the differential diagnosis of eight liver diseases are summarized. (C.H.)

32069 NECESSITY OF PURIFICATION OF COMMERCIAL RADIOIODINATED LIPIDS IN THE ABSORPTION TESTS. Asakura, Hitoshi; Nosaki, Manabu; Tsuchiya, Masaharu; Sambe, Ken (Keio Univ., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 427-9(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Results of tracer studies of fat metabolism using purified ^{131}I-triolein corresponded to that of ^{14}C-triolein absorption test in animal experiments and fat balance studies in clinical investigations. The results indicate the necessity of the purification of commercial ^{131}I-triolein. But even purified ^{131}I-triolein can not be used in fat absorption test because of influence of metabolized radioiodinated lipids if blood radioactivity is taken as the index for fat absorption. (auth)

32070 PRESENT STATUS OF NUCLEAR MEDICINE IN JAPAN. Kakehi, H. (Chiba Univ., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 621-4(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The status of nuclear medicine in Japan during 1969 is reviewed. Topics discussed include applications of radioisotope scanning in diagnosis, the labeled compounds and radioisotopes, and the scanning instruments used. (C.H.)

32071 PROBLEMS OF BONE SCINTIGRAPHY BY SHORT-LIVED RADIONUCLIDES. Scheer, K. E. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 628-34(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The advantages of using short-lived radioisotopes for bone scanning are reviewed. Results using ^{18}F and metastable ^{87}Sr are reported. The performance of a positron camera for the visualization of ^{18}F uptake by bone lesions is discussed. (C.H.)

32072 A CRITICAL STUDY OF THE CONTRIBUTION OF BONE SCINTIGRAPHY TO THE DIAGNOSE IN ORTHOPAEDIC CONDITIONS. De Roo, M. J. K.; Kestelijn, P. J. Belge Radiol.; 52: 220-33(1969).

The usefulness of ^{85}Sr or ^{87}Sr bone scintigraphy in patients referred to a department of orthopedic surgery was investigated. The results of bone scan in a few cases with malignant diseases confirm the reliability of this technique for the detection of bone cancer. It was also of value in some types of osteomyelitis. Tracer concentration was found in numerous other bone diseases, but since the information was aspecific, the results of bone scintigraphy must be interpreted while taking into account the results of other types of examination. (C.O.)

32073 CLINICOPATHOLOGIC ANALYSIS OF CRYOHYPOPHYSECTOMY IN PATIENTS WITH ADVANCED CANCER. Norrell, Horace; Alves, Angelo M.; Winternitz, William W.; Maddy, James (Univ. of Kentucky, Lexington). Cancer; 25: 1050-60(May 1970).

Serial sections of the sella turcica were obtained in 18 autopsy specimens of patients with advanced breast and prostatic carcinoma who had undergone extensive endocrine testing before and after cryoablation of the pituitary gland. Cryohypophysectomy, a technique which requires neither craniotomy nor general anesthesia, resulted in 90% or greater destruction of the anterior lobe of the pituitary in 11 cases; destruction was complete in three

cases. Persistence of human growth hormone following cryohypophysectomy determined by radioimmunoassay, was the most reliable indication of residual anterior pituitary function, but even this was an unreliable index when less than 10% of the pituitary gland remained viable. Withdrawal of corticosteroids resulting in an adrenal crisis following operation proved a poor technique to determine the adequacy of pituitary destruction. Length and extent of tumor remission did not seem to be dependent upon the degree of pituitary destruction. Based upon experience with 60 patients having cryohypophysectomy for advanced carcinoma, CSF rhinorrhea and persistent diabetes insipidus each occurred in 10% of the cases. (auth)

32074 ASSESSMENT OF FUNCTION IN THE TRANSPLANTED KIDNEY WITH ^{131}I HIPPURAN. Rodriguez-Antunez, Antonio; Gill, Wilfrid M. Jr.; Egleston, Thomas A. (Cleveland Clinic Foundation). J. Urol.; 103: 574-6(May 1970).

Determination of the status of a transplanted kidney is complicated. The first step in many cases is to establish whether the homograft is viable in the immediate post-transplantation period when the patient is anuric. Rejection, ureteral obstruction and leakage are complications that occur post-transplantation and require careful attention. Three tests were performed routinely to help evaluate the status of patients with a transplanted kidney. There were 315 scans using ^{131}I-hippuran and 145 renograms performed in 207 patients who underwent renal transplantation. The $T_{\frac{1}{2}}$ blood clearance was performed only in the last 33 patients, a total of 60 determinations. The results of scintigraphy, renography, and the $T_{\frac{1}{2}}$ clearance rate demonstrate that the renogram is of little value because of the incidence of falsely positive test, the scintigram is the most valuable test to determine viability of the kidney and to demonstrate infarction, and the $T_{\frac{1}{2}}$ blood clearance determination is the most sensitive test in the detection of rejection. (C.H.)

32075 RECENT ADVANCES IN DIAGNOSTIC GASTROENTEROLOGY. Battersby, Cameron (Queensland Univ., St. Lucia, Australia). Med. J. Aust.; 963-7(9 May 1970).

This review of diagnostic refinements includes summaries of progress in radiology and radioactive scintiscanning. The applications of angiography to arterial, abdominal and gastro-intestinal locating of lesions are briefly covered. Radioisotopes used for hepatic and pancreatic scanning are compared. (auth) (Australia)

32076 ^{99m}Tc SCINTIPHOTOGRAPHY IN ARTHRITIS. I. TECHNIC AND INTERPRETATION. McCarty, Daniel J.; Polcyn, Robert E.; Collins, Phillip A.; Gottschalk, Alexander (Argonne Cancer Research Hospital, Chicago. Univ. of Chicago). Arthritis Rheum.; 13: 11-20(Jan-Feb 1970).

A technique for visualization of inflamed joints using intravenously injected technetium-99m as pertechnetate and an Anger (scintillation) camera for detection will be described. Contrast between inflamed and normal tissue was usually greatest in the first few minutes after isotope injection, presumably, at the time of maximal difference in concentration of ^{99m}Tc between blood and extravascular tissue. Inflamed joints with moderate to large effusions were often visualized best 1–2 hr after injection. The extensive binding of pertechnetate by plasma and joint fluid proteins found in equilibrium dialysis experiments was evoked as an explanation of this phenomenon. (auth)

32077 DETECTION OF LIVER TUMORS BY SCINTIGRAPHY AND ELECTRONIC DATA PROCESSING. Winkler, C.; Esser, G. Arch. Klin. Chir.; 322: 151-3(1968). (In German).

The use of ^{99m}Tc to detect liver tumors as small as 1.5 cm in radius by means of scintigraphy was demonstrated in phantoms, and a system of liver scintigraphy based on detection with a γ camera, oscilloscope, and an x-y plotter or printer was discussed. In order to avoid the shifts in liver position caused by respiration in patients and the unsharpness of the ^{99m}Tc scintigraphic image obtained from the injected ^{99m}Tc, the patient was directed to stop respiration during the few seconds required for detection of the ^{99m}Tc liver distribution by the γ camera. The ^{99m}Tc distribution data obtained was processed by a computer and displayed on an oscilloscope screen in a format of isointensity lines. The ^{99m}Tc isointensity lines also were presented on an x-y plotter or high speed printer. In this way it was possible to demonstrate ^{99m}Tc differences more definitely and quickly than conventional scintigraphic equipment and procedures. (BBB)

32078 DEVELOPMENT OF NUCLEAR MEDICINE METHODS FOR THE DIAGNOSIS OF BRAIN DISEASE. Morczek, A.; Parnitzke, K. H. (Medizinische Akademie, Magdeburg, Ger.). Kerntechnik; 11: 635-46(Nov 1969). (In German and English).

Techniques and uses of various nuclear medicine diagnostic methods are discussed with particular emphasis on standard gamma encephalography, the Anger gamma camera technique, and certain angiographic techniques combined with the use of radionuclides. The definitive confirmation of exclusion of brain tumors requires the combined use of several techniques. Standard gamma encephalography is particularly valuable for the early detection of brain tumors and of post-operative and post-irradiation tumor relapses. (auth)

32079 PVP STABILISED INDIUM SULPHIDE COLLIOD FOR LIVER AND SPLEEN SCANNING. Szymendra, J.; Kaminska, J.; Radwan, M.; Zoltowski, T. (Inst. of Oncology, Warsaw). Brit. J. Radiol.; 42: 944-5(Dec 1969).

The method reported is basically that for ^{99m}Tc sulfide-carrier rhenium sulfide colloid production. The major advantages of the procedure described are as follows: The preparation is of relatively large particles, the competitive uptake by bone marrow is low, and the scans of liver and spleen good; the preparation is safe; and the use of a colloid makes the preparative run simple and rapid and gives reproducibility of reaction conditions. (UK)

32080 ASPECTS OF DIAGNOSIS AND MANAGEMENT OF INTRACRANIAL GLIOMAS. Fields, William S. (Baylor Univ., Houston, Tex.). pp 285-307 of Methods in Cancer Research, Vol. IV. /Busch, Harris (ed.). New York; Academic Press Inc. (1968).

Current methods of diagnosis and localization and their value in planning rational surgical or medical therapeutic regimens are discussed. Included in the review are the characteristics of several types of gliomas. The value of angiography, plain radiography, and radioisotope scanning for diagnostic purposes and the use of surgical and nonsurgical (including radiotherapy) methods of treatment are discussed. (59 references) (C.O.)

32081 URINARY PARTICLE DYNAMICS AND VESICOURETERAL REFLUX IN THE HUMAN. Corriere, Joseph N. Jr.; Sanders, Theodore P.; Kuhl, David E.; Schoenberg, Harry W.; Murphy, John J. (Univ. of Pennsylvania, Philadelphia, Harrison Dept. of Surgical Research, Philadelphia). J. Urol.; 103: 599-602(May 1970).

Suspensions of ^{99}Tc-labeled sulfur colloidal particles simulating bacteria were placed into ileal segments of patients with free ureteral reflux and ureteroileostomies. Serial radionuclide scans were made for five hours and estimates of particle disappearance rates were made. In these patients, refluxed radiopaque medium was promptly returned to the segment in 30 minutes. Refluxed particles remained from two to 10 times longer. (auth)

32082 THE RADIOPHARMACIST IN NUCLEAR MEDICINE: PREPARATION OF ^{99m}Tc HUMAN SERUM ALBUMIN MACROAGGREGATES. Bowen, Barry M.; Wood, Donald E. (Toronto General Hospital). Amer. J. Hosp. Pharm.; 26: 529-34(Sep 1969).

The development of ^{99m}Tc-labeled human serum albumin macroaggregates was used to illustrate methods and procedures for quality control testing, formulation, and preparation of a radiopharmaceutical product. Some of the factors considered were assays such as physical half-life, specific activity nuclide identity, radionuclide and radiochemical purity, strength, chemical purity, sterility, and pyrogenicity. Specific criteria for acceptance of a ^{99m}Tc aggregate were outlined in detail. A method for preparation of ^{99m}Tc-human serum albumin and two alternate methods for preparation of ^{99m}Tc-human serum macroaggregates were presented. Testing procedures for measurement of ^{99m}Tc-macroaggregate particle size on a bright line hemocytometer were described. Chromatographic test procedures for radiochemical purity, and radionuclide measurements to ensure against ^{99}Mo breakthrough, were described. Results of distribution curves for 26 lots of commercial ^{131}I-macroaggregates were presented. The average distribution of particles was 5 to 25 μ in 19 lots and 25 to 30 μ in 4 lots. Only 4 particles greater than 100 μ diameter were observed. Of these 2 were seen in 1 batch. In all 4 cases, the particles greater than 70-μ diameter were composed of many loosely clumped particles and did not appear to be a firmly formed single large macroaggregate. A critique of ^{99m}Tc-macroaggregates prepared by the procedures listed was presented. As compared to the tests outlined and clinical criteria established the preparation methods used were found to differ appreciably. Incomplete random sampling of suppliers' products showed that these products sometimes did not meet acceptability criteria. (BBB)

32083 BRAIN SCANNING AND INTRACRANIAL INFLAMMATORY DISEASE. Davis, David O.; Potchen, E. James (Washington Univ. School of Medicine, St. Louis). Radiology; 95: 345-6(May 1970).

Of 50 patients with brain abscess 16 underwent brain scanning with ^{203}Hg chlormerodrin, ^{197}Hg chlormerodrin, and ^{99m}Tc pertechnetate; scans were positive in all cases. In addition, two pa-

tients with surgically proved Herpes simplex encephalitis showed positive scans. Autopsy in one case revealed numerous smaller abscesses scattered throughout the brain in addition to a large cerebellar abscess correctly identified by scanning and ventriculography. (auth)

32084 THE DETERMINATION OF Cu BY ACTIVATION ANALYSIS IN LIVER PUNCTATES IN MORBUS WILSON. Moellmann, H.; Henke, G.; Alfes, H. (Univ., Muenster, Ger.). Z. Klin. Chem. Klin. Biochem.; 7: 647(Nov 1969). (In German).

In two patients suffering from morbus Wilson puncture, biopsies of the liver were obtained. These, together with a copper standard, were welded into a quartz ampule. These were exposed in a reactor for 24 hours to thermal neutrons with a flux of 5×10^{13}. Subsequently, the preparations were wet ashed and the copper extracted with chloroform. The solution was then measured with a scintillation crystal and multichannel analyzer. Untreated, the patients showed copper values ten times higher than normal. After appropriate treatment, the copper content became almost normal. (H.B.G.)

32085 EVALUATION OF RADIONUCLIDE SOURCES FOR TRANSMISSION SCANNING. Sorenson, James A. (Univ. of Wisconsin, Madison). Invest. Radiol.; 5: 92-102(Mar-Apr 1970).

An evaluation of radionuclide sources currently available for transmission scanning was carried out using transmission scans of aluminum phantoms and human subjects. Sources investigated included ^{125}I, ^{241}Am, ^{210}Pb, ^{99m}Tc, and ^{137}Cs. By categorizing these sources according to photon energy, it was concluded that low-energy sources (< 40 keV) are useful only for thin sections or small animals, intermediate energy sources (40 to 80 keV) are optimal for thicker sections that contain bony structures such as the pelvis, and that high energy sources (> 80 keV) are optimal for thick sections with air cavities, such as the lung, or with heavy bone structures, such as the skull. Other potentially useful sources are discussed in light of these conclusions. (auth)

32086 SCREENING THE CRANIAL VAULT AND ITS CONTENTS BY SCANNING WITH ^{99m}Tc. Olson, Marvin H.; Briggs, Russell C. (Univ. of Wisconsin, Madison). Wis. Med. J.; 68: 153-9(Apr. 1969).

The advantages and uses of ^{99m}Tc for brain scanning were discussed. The intravenous dose was administered usually at the antecubital site, and was 100 μCi/g body wt, with a maximum dose of 15 mCi and a minimum dose of 2.5 mCi given 10 to 15 min prior to scanning. Damage to the blood-brain barrier showed up as infection, infarction, or tumor formation areas of increased uptake. Increased activity was also evident when increased vascularity accompanied tumor growth, as seen in some meningiomas. Where the vascular structures were displaced by a lesion such as an arachnoid cyst, the areas of activity were shifted. There was a negative defect with reduced activity because of the avascular nature of the cyst. The abnormality was due to displacement of the normal blood pool and change of configuration due to extrinsic pressure. Other lesions that caused a shift in the activity included porencephalic cysts and unilateral hydrocephalus. There was increased ^{99m}Tc activity due to abnormalities in the vasculature. This was demonstrated in the scans of A-V malformations, in the increased number of vessels in fibrous dysplasia, and also where growing neoplasms were accompanied by new vessels. These changes were present in hyperostosis, Paget's disease, osteomas, and metastases. In subdural hematoma there was compression of normal brain by extravascular blood with localized increased activity in fluid and membrane. A large crescent-shaped pattern of increased activity was seen on anterior and posterior views. Other causes of the crescent sign included occlusion of the external carotid, absence of a bone flap, subdural empyema, chronic pachymeningitis, unilateral bone lesion, subgaleal hematoma, and scalp trauma. In degenerative diseases such as stroke there was localized increase in ^{99m}Tc activity due to infarction or hemorrhage damaging the blood-tissue interface. The incidence of positive scans in strokes was estimated to be 56% in patients who had hemorrhagic lesions. (BBB)

32087 THE INFLUENCE OF TISSUE BACKGROUND RADIOACTIVITY ON THE APPARENT RENAL ACCUMULATION OF RADIOACTIVE COMPOUNDS. Farmelant, Melvin H.; Sachs, Charles E.; Burrows, Belton A. (Univ. Hospital, Boston. Boston Veterans Administration Hospital. Boston Univ. Medical Center). J. Nucl. Med.; 11: 112-17(Mar 1970).

The use of the upper chest as a measure of nonrenal tissue background in the renal areas was validated in dogs and patients. The role of tissue background in altering the curves of renal accumulation of radioisotopes was then explored. The ratio of renal accumulation by the two kidneys would, from physiological considerations, be expected to remain constant for short times. Comparison of total counts in the renal areas reveals a varying ratio of uptake in people with significant discrepancies in initial counting rate. After tissue background is subtracted, the net kidney curves show a constant ratio of uptake in time in all cases. Evaluations of renal functions based on comparisons of uptake are dependent on significant differences in initial uptakes. It is suggested that methods of evaluation that reflect renal retention of radioisotopes are more sensitive in detecting renal artery disease. (auth)

32088 SCINTILLATION CAMERA PATIENT-PICTURE ORIENTATION. Dratz, Arthur F.; Coberly, James C. (Veterans Administration Hospital, Atlanta). J. Nucl. Med.; 11: 144-5 (Mar 1970).

A simplified method for the selection of proper orientation control settings for scintillation camera pictures is described. The method can be adapted to both the Nuclear-Chicago and Picker gamma cameras. The pictures are oriented by relating the patient directly to the four quadrants of the detector head. (C.H.)

32089 IS FIELD SIZE ENLARGEMENT WITH DIVERGENT AND PINHOLE COLLIMATORS ACCEPTABLE? Hayes, Michael (Harbor General Hospital, Torrance, Calif.). Contract AT(04-1)-Gen-12. Radiology; 95: 525-8(Jun 1970).

In all but a few of 100 patients scanned using ^{99}Tc or ^{133}Xe and a gamma camera, the divergent collimator allowed both lungs to be encompassed in one view. Phantom studies using ^{113}In demonstrated mild-to-moderate image distortion. There was a 50% loss of sensitivity but no loss in resolution when the divergent collimator was compared with its 1000 parallel-hole counterpart designed for the same energy range. The pinhole collimator introduces moderate-to-severe image distortion and sacrifices efficiency too much for the accompanying gain in resolution and field size enlargement. A need exists for a sister divergent collimator designed for the 80 to 140 keV energy range. (auth)

32090 CONGENITAL COMMUNICATING HYDROCEPHALUS WITH ELEVATION OF THE TRANSVERSE AND CONFLUENT SINUSES. CASE REPORT. Mansfield, Carl M.; Park, Chan (Thomas Jefferson Univ. Hospital, Philadelphia). Radiology; 95: 585-6(Jun 1970).

A case of congenital communicating hydrocephalus with ^{99}Tc scan findings suggesting Dandy–Walker cyst is presented. Congenital communicating hydrocephalus should be considered in patients with elevation of the confluent and transverse sinuses. (auth)

32091 ^{81m}Kr GENERATOR AND ITS USES IN CARDIOPULMONARY STUDIES WITH THE SCINTILLATION CAMERA. Jones, T.; Clark, J. C.; Hughes, J. M.; Rosenzweig, D. Y. (Hammersmith Hospital, London). J. Nucl. Med.; 11: 118-24(Mar 1970).

The properties of the gamma camera make it an important instrument for physiological studies of short duration. Thus specific isotopes are required to play a complementary role with the camera in these investigations. Such isotopes must be available in sufficient activities to make short duration studies statistically feasible, and yet they must have the physical characteristics to meet the requirements of high resolution and low absorbed dose to the patient. It was possible to obtain the quantitative time course of the ^{81m}Kr as it passes through the heart by simply masking off on the oscilloscope screen all regions other than the right side of the heart and then replaying the tape and counting the dots as they appear on the screen with a photomultiplier. Other clinical applications using ^{81m}Kr in air-gas mixtures or aqueous solutions include lung ventilation studies and lung perfusion studies. A ^{81}Rb generator for the production of ^{81m}Kr in the gas phase is described. It is concluded that the $^{81}Rb-^{81m}Kr$ generator has a useful role to play in medicine in association with gamma cameras. (C.H.)

32092 THE USE OF THE RENAL UPTAKE OF ^{197}Hg AS A METHOD FOR TESTING THE FUNCTIONAL VALUE OF EACH KIDNEY. Raynaud, C.; Ricard, S.; Karam, Y.; Kellershohn, C. (Service Hospitalier Frederic Joliot, Orsay, France). J. Nucl. Med.; 11: 125-33(Mar 1970).

The renal uptake of mercury depends closely on renal function. The uptake value of ^{197}Hg, measured by external counting, allows the quantitative estimation of the functional value of each kidney. With normal kidneys the level of uptake of the right and left kidneys, respectively, is $27.0 \pm 3.5\%$ and $26.0 \pm 3.5\%$ of the injected dose; the global uptake is $53 \pm 6\%$. Mercury uptake has been measured in different kidney conditions. In the case of a solitary kidney, the uptake is equal to or greater than 47.0 when the kidney is sound and less than 47.0 when the kidney is pathological; when there is a unilateral nephropathy, the uptake of the sound kidney is greater than normal, compensating for the hypofixation of the pathological side, and global uptake is normal, i.e., ≥ 47.0; when

there is a bilateral nephropathy, if the lesions are symmetrical, uptake is equally low in both kidneys; if the lesions are disymmetrical the less affected kidney will have a higher uptake than the other, but in both cases the global uptake is always less than normal. (auth)

32093 ^{99m}Tc–IRON HYDROXIDE AGGREGATES FOR LUNG SCANNING. Bruno, Fred P.; Brookeman, Valerie A.; Arborelius, Mans; Williams, Clyde M. (Univ. of Florida, Gainesville. Veterans Administration Hospital, Gainesville, Fla.). J. Nucl. Med.; 11: 134-7(Mar 1970).

A simple method for incorporating ^{99m}Tc into iron hydroxide particles using sterile, pyrogen-free reagents is described. The compound consists of particles with a size distribution of 3 to 30 microns. Internal distribution studies using rabbits show that about 84% of the intravenously injected radioactivity is trapped by the lung, the remainder being deposited mainly in liver (7%) and carcass (7%). Clinical studies have resulted in excellent lung scans. Hazards from radiation and iron toxicity are considered to be negligible. (auth)

32094 RADIOSTRONTIUM IN THE SCANNING OF SKELETAL METASTASES. Roncari, G.; Bagliani, G.; Bergonzi, M. (Univ., Milan). Radiol. Med.; 55: 943-58(Oct 1969). (In Italian).

Skeletal scanning with radiostrontium (^{85}Sr and ^{87m}Sr) in 75 patients with suspected or ascertained bone metastases is reported. Only 4% false negatives were observed in patients with already documented metastases; there was generally a close agreement between the scan and the radiographic data with regard to the extent of the pathological process. In subjects with suspected metastasis and a negative radiographic picture, a positive scan was observed in 7 cases (19%); in those with clinically suspected metastasis and ambiguous radiographic pictures, radiostrontium was accumulated in 7 cases (58%). These results permit a favorable judgment of the technique in the early detection of bone metastasis and its value as a complement to radiography is stressed. It is held that there are good reasons for preferring ^{87m}Sr to ^{85}Sr in scintigraphic studies. (auth)

32095 CURRENT PROBLEMS IN SCINTIGRAPHY AND FUTURE PROSPECTS. Roucayrol, J. C. (Hopital Cochin, Paris). Presse Med.; 77: 1233-4(Aug-Sep 1969). (In French).

Characteristics of moving and stationary scintigraphic detectors, and radioisotopes such as ^{99m}Tc, ^{198}Au, ^{87m}Sr, ^{75}Se, ^{131}I, and ^{197}Hg were discussed. Moving detectors are relatively simple in design, as compared to stationary detectors, and their main defect is their slowness. In order to decrease the time required for a scan, large quantities of radioisotopes must be administered. Unless the half-life of the radioisotope is short, the patient may be exposed to considerable irradiation. An alternative method is to use a normal velocity of detector movement, but also to use multiple detectors. However, the costs of this type of equipment are frequently excessive. The spark chamber is an example of a stationary detector whose sensitivity is limited. The use of the scintillation camera has become widespread, partly because of the wide range of accessories that can be used with it, such as the multichannel analyzer. The radioisotopes most suitable for use in scintigraphy usually have a short half-life, adequate γ emission, low toxicity, immunological neutrality, and specificity of organ localization. Thus uses and mechanisms of localization for ^{99m}Tc compounds in brain, placenta, lung, liver, spleen, and thyroid, ^{198}Au in liver, ^{87m}Sr in bone, ^{75}Se in pancreas, ^{197}Hg in kidney, and ^{131}I in thyroid and lung were reviewed briefly. (BBB)

32096 SCINTILLATION SCANNING OF LUNGS IN PREOPERATIVE ASSESSMENT OF CARCINOMA OF BRONCHUS. Walker, R. H. Secker; Provan, J. L. (University Coll. Hospital, London). Brit. Med. J.; 3: 327-30(9 Aug 1969).

The lung scans were carried out with ^{99m}Tc-labeled macroaggregated human serum albumin before thoracotomy. Tumors less than 2 cm in dia on the chest radiograph were not detected. Larger tumors showed defects in ^{99m}Tc perfusion, ranging in size from the mass seen on the chest radiograph to almost absent perfusion of the entire lung. The extent of the defect in ^{99m}Tc perfusion was closely related to involvement of the pulmonary vessels at the hilum by distortion, compression, or invasion by the tumor. Bronchial obstruction played a less important part in producing the defects. The larger the defect in ^{99m}Tc perfusion the greater was the involvement of the hilar and mediastinal structures and the more extensive was the surgery required. When ^{99m}Tc perfusion of the affected lung was less than one third of the total, the tumor was found to be unresectable. (BBB)

32097 EMPLOYMENT OF ^{87m}Sr IN DIAGNOSTIC SKELETAL SCANNING. Sanguineti, M.; Durand, D. (Ospedali Galliera, Genoa). Radiol. Med.; 55: 959-69(Oct, 1969). (In Italian).

The biological behavior and spatial distribution of ^{87m}Sr overlap those of ^{85}Sr, whereas its half-life of 2.8 hours ensures a very low irradiation risk. Fifteen patients were scanned with both isotopes. It was found that ^{87m}Sr: reveals pathological conditions at least as clearly as ^{85}Sr; presents excellent definition of areas of hyperactivity; does not lead to the risk of false positive results due to the accumulation of the tracer in the intestine, the collection of radioactivity in the urinary tract can be easily observed, and its duration is appreciably shorter; and in comparison with radiological examination has the same advantages and disadvantages as ^{85}Sr. (auth)

32098 ISOTOPIC DETERMINATION OF THE FETAL–PLACENTAL BLOOD MASS DURING AN EXSANGUINATION-TRANSFUSION IN UTERO. Bru, A.; Lucot, H.; Naja, A.; Bierme, R.; Bierme, S.; Pontonnier, G. (Centre Regional Anticancereux, Toulouse). Rev. Med. Liege; 23: Suppl. No. 1, 271-3(Oct 1968). (In French).

Measurement of the fetal–placental blood volume of an infant in utero by ^{51}Cr-labeled red cells was described. More than 15 min was required before the ^{51}Cr reached an equilibrium distribution in the placental circulation. The irradiation dose received by the fetus was estimated to be of the order of a few mRads; and was much less than the irradiation dose from a radiological examination or a placentography with labeled human serum albumin. One of the chief advantages of measurement of the fetal–placental blood volume by ^{51}Cr was that it permitted the total volume of blood required for replacement by transfusion to be evaluated in hemolytic disease in utero. The method of injection of the ^{51}Cr was illustrated and described. (BBB)

32099 THE OCCULT THYMOMA: RADIOLOGICAL AND RADIOISOTOPIC AIDS TO DIAGNOSIS. Hare, W. S. C. (Melbourne Univ., Parkville, Australia); Andrews, J. T. Australas. Ann. Med.; 19: 30-3(Feb 1970).

Thymomata which are too small to be detected by plain radiography may be demonstrated by pneumomediastinography, thymic venography, and selenomethionine scanning of the mediastinum. These techniques were valuable in demonstrating a tumor in a woman with myasthenia gravis, leading to thymectomy. (auth) (Australia)

32100 TECHNETIATED ALBUMIN AND PLACENTAL LOCALIZATION. Beck, C.; Vilayleck, S.; Gillet, M.; Blanquet, P. (Hopital Saint-Andre, Bordeaux). Rev. Med. Liege; 23: Suppl. No. 1, 72-3(Oct 1968). (In French).

The use and advantages of ^{99m}Tc-labeled human serum albumin for placental localization were discussed. As compared to ^{51}Cr-labeled erythrocytes, which have been used for this purpose, ^{99m}Tc-labeled human serum albumin gave improved localizations. Discontinuous measurements of the various sectors of the abdomen were inadequate to define the inferior margin of the placental mass, so that marginal segmental or lateral placental insertions could not be differentiated. The activity measured in the various abdominal areas varied very rapidly with time, with differences of as much as 40% within 20 min. For this reason it was found that better results were obtained when a γ scintillation camera was used. The image was retained on the memory oscilloscope for subsequent study. The speed of placental examination by this method increased considerably the number of placental scans that could be completed. The radiation hazard when ^{99m}Tc-labeled human serum albumin was used was small and without substantial risk for the fetus and the mother. The high sensitivity of the γ camera made it possible to use as little as 1 mCi of ^{99m}Tc for each scan. The initial usable image was obtained within $\frac{1}{2}$ hr after injection. This was necessary in order to avoid visualization of ^{99m}Tc in the bladder, which occurs within $\frac{3}{4}$ hr after injection as a result of separation of ^{99m}Tc from the albumin and its renal excretion. (BBB)

32101 A FEASIBILITY STUDY OF A SCREENING TEST FOR ABNORMALITIES OF CAROTID BLOOD FLOW USING ^{99m}Tc. Britton, K. E. (Middlesex Hospital Medical School, London). J. Neurol., Neurosurg., Psychiat.; 32: 379-82(Oct 1969).

Studies were undertaken using phantoms to determine the feasibility of measuring an index of right and left carotid blood flow. The structure of the orbits is such that it should be possible to focus on each carotid vessel at the apex of each orbit if suitably designed collimated scintillation detectors were used. An experiment was undertaken to study whether discrimination is possible between ^{99m}Tc radioactivity in the 2 carotid vessels in this region of the skull. A skull was set up with plastic tubes of appropriate size bent into the shapes of the carotid vessels in the carotid siphon and cavernous sinus. Then 100 μCi of ^{99m}Tc was introduced into each tube. This is equivalent to the amount likely to be present in each carotid with the first circulation after an in-

travenous injection of 5 mCi ^{99m}Tc. A pair of suitably designed focusing collimators was used to separate the arrival times in the 2 carotids of an injected bolus of ^{99m}Tc. A pair of 18-hole lead collimators was designed. Differences in velocity flow could be related to differences in volume flow in the system described. Immediately after an intravenous injection of ^{99m}Tc for brain scanning, using scintillation detectors positioned over each orbit and the anterior chest, it appeared feasible to screen for functionally significant stenoses of carotid vessels. (BBB)

32102 INDIRECT RADIOISOTOPE LYMPHOGRAPHY IN ONCOUROLOGY AND ONCOGYNECOLOGY. Dubovyi, E. D.; Malyshkevich, A. B.; Antipov, S. G. (Regional Oncological Dispensary and Medical Inst., Odessa). Vop. Onkol.; 15: No. 10, 60-4(1969). (In Russian).

In injection of an indicated dose of ^{98}Au with the addition of lidase in the first inter-digital intervals of both feet a distinct image of inguinal, iliac, and para-aortic lymph nodes was obtained in 78 patients, of whom 15 were known to have no metastatic affection of the lymph system; in 63 cases there were malignant neoplasms in the urogenital system (carcinoma of the cervix uteri—30 cases, of the vulva—3, cancer of the bladder—13, prostatic carcinoma—11, carcinoma of the penis—4, and seminoma—2). A day after injection of the tracer the homogenous and dense type of shading was defined over unaffected lymph nodes. Twenty-seven patients showed disturbances in capacity of lymph nodes to accumulate ^{98}Au that suggested the presence of metastases. In 47 cases the findings of radioisotopic lymphography were confirmed by surgery or by dynamic clinical observations. The method of indirect radioisotopic lymphography is relatively simple, provokes no complications, and may be used for detecting metastases in lymph nodes that can not be found clinically in malignant neoplasms of the urogenital system. (auth)

32103 MORPHOLOGIC AND FUNCTIONAL STUDY OF THE THYROID WITH ^{99m}Tc. Cheguillaume, J.; Malinowski, A.; Robillard, J.; Bloquel, J.; Couette, J. E.; Minier, J. (Centre Paul-Papin, Angers, France). Rev. Med. Liege; 23: Suppl. No. 1, 73-7(Oct 1968). (In French).

The characteristics and advantages of the use of ^{99m}Tc for study of thyroid metabolism were discussed. The accumulation of ^{99m}Tc-pertechnetate ion by thyroid was prevented by administration of perchlorate salts, indicating that pertechnetate did not participate with ^{131}I in the organic phases of thyroid metabolism, and ^{99m}Tc uptake was a measure of ionic uptake only. The uptake of ^{99m}Tc required cellular integrity, metabolic energy, and presence of K ions. The maximum uptake of ^{99m}Tc occurred during the first hr after administration, and the ^{99m}Tc remained in the thyroid for periods of about 12 hr. Dosimetric studies have shown that following administration of 1 mCi of ^{99m}Tc the thyroid irradiation dose was 100 mrad, and the doses to the stomach and gonads were 300 mrad and from 12 to 18 mrad, respectively. Thus, the thyroid irradiation dose was about $^1/_{1000}$ times as great as with 50 μCi of ^{131}I, and from $^1/_5$ to $^1/_{10}$ times as great as with 50 μCi of ^{132}I. Morphological studies showed that ^{99m}Tc uptake distinguished between cold and hyperactive thyroid nodules as well as ^{131}I did. Characteristic % uptakes for ^{99m}Tc 1 hr after administration were 4.2% in normal thyroid, 22% in hyperthyroidism, and only 1% in hypothyroidism. In toxic adenomas the uptake of ^{99m}Tc was very rapid. The mechanism of ionic concentration of ^{99m}Tc could be studied without having to block organic synthesis in the gland, or altering thyroid function. In patients who had received antithyroid drugs, the uptake of ^{99m}Tc was unaltered, while that of ^{131}I was markedly affected. (BBB)

32104 ^{99m}Tc, A MEDICAL EMITTER WITH MULTIPLE POTENTIALITIES. Becquevort, P. A. (Univ., Liege). Rev. Med. Liege; 23: Suppl. No. 1, 84-92(Oct 1968). (In French).

The characteristics of ^{99m}Tc were compared to other short-lived radioisotopes, such as ^{132}I, ^{68}Ga, ^{87m}Sr, ^{137m}Ba, ^{113m}In, ^{188}Re, ^{42}K, ^{191m}In, ^{109m}Ag, and ^{77m}Se. The scheme of disintegration of ^{99}Mo to produce ^{99m}Tc was described in detail. The requirements for production of ^{99m}Tc from ^{99}Mo included complete separation of ^{99m}Tc from ^{99}Tc, complete absence of ion exchanges from the eluate, and absence of ^{99}Mo as a radiocontaminant. Relative activities of ^{99m}Tc and ^{99}Mo in the generator column and eluate were illustrated for elution effectivities of 80 to 90%. The absorbed irradiation doses in several organs were compared for ^{99m}Tc-pertechnetate, administered intravenously with and without perchlorate, and orally, as ^{99m}Tc-labeled human serum albumin and ^{99m}Tc sulfide, each given intravenously. The irradiation doses from 10 mCi of intravenously injected ^{99m}Tc-pertechnetate to whole-body, thyroid, stomach, large intestine, male and female gonads, and liver were 130, 1100, 1000, 1500, 120, 160, and 700 mrad respectively. When given with perchlorate the irradiation doses were 120, 90, 590, 960, 120, and 150 mrad. Oral ^{99m}Tc gave doses of 140, 2100, 1400, 2900, 120, and 180 mrad. When 1 mCi of ^{99m}Tc-labeled human serum albumin was given for placental scanning the whole-body maternal dose was 5 mrad and the fetal whole-body dose was 14 mrad. The blood irradiation doses for mother and fetus were 47 and 14 mrad, respectively. The irradiation doses from 3 mCi of ^{99m}Tc-sulfide, after intravenous injection were, for whole-body, male and female gonads, liver, spleen, bone marrow, and blood, 50, 40, 70, 720, to 1200, 480 to 1300, and 70 to 1000 mrad, respectively. (BBB)

32105 SUITABILITY OF PANCREATIC SCINTIGRAPHY. Beck, C.; Gillet, M.; Courtois, J.; Balagayrie, J. C.; Blanquet, P. (Hopital Saint-Andre, Bordeaux). Rev. Med. Liege; 23: Suppl. No. 1, 112-13(Oct. 1968). (In French).

Problems that are encountered in pancreatic scintigraphy with ^{75}Se and ^{198}Au were reviewed and discussed. The basic procedure included the use of a scintillation camera and a multichannel analyzer. The radioactivity measured was stored, according to its x and y coordinates, in the analyzer. The stored data was available for recording. The level of storage in each channel could be controlled visually and numerically, and the scintigraphic image could be reconstructed from the stored data. In order to subtract the ^{75}Se deposited in liver so that the pancreatic deposition of ^{75}Se could be evaluated, colloidal ^{198}Au that deposited in the liver but not in the pancreas was used. In order to discriminate between the ^{75}Se and ^{198}Au, it was found advisable to inject the ^{198}Au after the ^{75}Se had been injected and measured, and to use a greater quantity of ^{198}Au than of ^{75}Se. The reason for this was to avoid interference between the Compton irradiation from the ^{198}Au, which included an energy located at the photoelectric peak of ^{75}Se. The ^{75}Se spectrum also included a small peak at 400 keV that represented 12% of the total activity, which was near the energy of the ^{198}Au. It was most important to measure the deposited ^{75}Se carefully, so that a clear image of the pancreas could be obtained. The method of electronic subtraction was described. It permitted the subtraction procedure to be interrupted at any time, and the results to be inspected visually. The results were recorded photographically. (BBB)

32106 QUANTIFICATION OF IMAGE STUDIES OBTAINED WITH A SCINTILLATION (ANGER) CAMERA. Loken, Merle K.; Ponto, Richard A.; Kush, George S. (Univ. of Minnesota Hospitals, Minneapolis). Radiology; 95: 505-16(Jun 1970).

Quantitative data including graphic analysis and contour plots from image studies of various body organs were obtained with a scintillation camera, digitalized, stored, and later processed by a CDC-3300 computer. Contours included serial studies of the passage of rapidly changing radioactive elements through an organ. Mathematical procedures utilized in developing contours appear to emphasize diagnostic information. Improvements in displaying radionuclide distributions, together with the relative simplicity and low cost of the technique make contour plots a valuable tool in nuclear medicine. (auth)

32107 INTRA-ARTERIAL RADIONUCLIDE CEREBRAL ANGIOGRAPHY. Rosenthall, Leonard; Chan, Jack; Stratford, Joseph (Montreal General Hospital). Radiology; 95: 325-32 (May 1970).

Eighty patients with a variety of intracranial afflictions were studied with the combined procedure of radiocontrast and radionuclide angiography. The radionuclide angiogram was obtained following an intracarotid or intravertebral artery injection of 10 millicuries ^{99m}Tc-labeled pertechnetate in a 10-ml volume for each of the lateral and frontal or occipital projections. Serial 0.5- to 1.0-second exposure scans were obtained. The radionuclide method is more sensitive to abnormal vasculature and perfusion than radiography but lacks the resolution of the latter. Evidence supports the continued use of the radionuclide method as a supplement to cerebral radiography. (auth)

32108 QUANTITATIVE ANALYSIS OF LIVER SCAN DATA AS AN AID TO DIAGNOSIS. Grassman, E. D.; Horgan, J. D.; Meade, R. C. (Marquette Univ., Milwaukee, Wood Veterans Administration Center, Milwaukee). Radiology; 95: 517-23 (Jun 1970).

Data for the digital-computer method are obtained from a scintillation camera and processed in a Linc-8 computer. Computer output consists of an oscilloscope display of the outlined liver and located defects plus print-out of the quantitative interpretation. Radioisotope scans belonging to either tumor or non-tumor groups give computed parameters from which the grouping is obtained and show probabilities of correct grouping. Defect- and organ-outlining techniques generally have proved successful, although some difficulties with tumors on the liver edge and fissure-type defects have been encountered. Preliminary investiga-

tion of the proposed analysis indicates that the normal liver and cirrhosis appear inseparable on this basis. (auth)

32109 RADIONUCLIDE CORONARY ANGIOGRAPHY AND MYOCARDIAL BLOOD FLOW. Christensen, Edward E.; Bonte, Frederick J. (Univ. of Texas, Dallas). Radiology; 95: 497-503 (Jun 1970).

Regional myocardial blood flow in dogs was studied with a scintillation camera and two different data recording and processing systems: videotape storage and a video scintillation counter; and magnetic tape storage and a small computer system designed to operate with a scintillation camera. A tracer bolus of ^{99}Tc-labeled serum albumin or pertechnetate ion, or ^{133}Xe dissolved in normal saline was injected into a coronary artery to generate flow curves of four arbitrary myocardial areas. An experimental coronary embolism was produced. Detectable and apparently significant changes in regional blood flow were produced in this manner. (auth)

32110 ROENTGENOLOGIC OBSERVATIONS OF LUNG CARCINOMA IN THE ABCC–JNIH ADULT HEALTH STUDY, 1950 TO 1968, HIROSHIMA–NAGASAKI. Nakata, Hajime; Matsuura, Keiichi; Russell, Walter J. (Atomic Bomb Casualty Commission, Hiroshima, Atomic Bomb Casualty Commission, Nagasaki, Japanese National Inst. of Health, Tokyo, Hiroshima Red Cross Hospital, A-Bomb Hospital, Hiroshima). Radiology; 95: 623-7(Jun 1970)

Roentgenograms in 29 cases of pulmonary carcinoma were reviewed for growth of lesions. In six cases, equivocal densities were evident at roentgenography twenty-three to sixty-two months before subsequent roentgenologic identification as carcinoma; thus 20% of the cases observed appeared to grow relatively slowly. These results further support the impression that a sizable percentage of pulmonary cancers have slow growth rates. In five other patients in this study, cancer developed in the same lobe showing residuals of pulmonary tuberculosis. (auth)

32111 IMAGING DISTRIBUTION OF RADIOACTIVITY WITHIN THE HUMAN BODY. II. COLLIMATOR POINT RESPONSE FUNCTION EFFECTS IN OPTIMUM DATA PROCESSING. Farrell, R. A.; Hart, R. W. (Johns Hopkins Univ., Silver Spring, Md.). Invest. Radiol.; 5: 103-10(Mar-Apr 1970).

The effects of collimator response function on optimum fidelity were investigated employing the mean-square fit measure of fidelity. At a fixed count rate the delta-function collimation response was optimal. The importance of this result is that the theoretic performance of the delta-function collimator gives an ideal standard for use in measurements of the performance of more practical collimators. In studying collimators of finite width the form of the collimator response function can have a significant effect on the accuracy of imaging the radioisotope distribution. One of the hypothetical clinical situations discussed suggests that choice of collimator shape can save a factor of ten or more in needed count total. With all collimator shapes considered, it was found that for fidelity one feature of a good collimator is that its resolution-width should be about one-half the width of the essential structure of the isotope distribution (when the expected count total is proportional to the square of the collimator resolution-width). (auth)

32112 FURTHER STUDIES IN LYMPHOKINETIC CONSIDERATIONS OF LYMPHOGRAPHY AND INTRALYMPHATIC THERAPY. Koehler, P. Ruben; McWilliams, Jane O.; Studer, Rebecca; Potchen, E. James (Washington Univ. School of Medicine, St. Louis). Radiology; 95: 399-401(May 1970).

Lymphangiography using ^{131}I-labeled Ethiodol was performed on the right leg of a dog. Popliteal-node activity was monitored, rose to a peak, and gradually leveled off to a fairly constant value. Two to seven days later lymphangiography using ^{125}I-labeled Ethiodol was repeated in the same leg to determine the amount of newly injected oil remaining in the node; ^{131}I activity was pushed out during this injection. The day after the second injection, percentage retention of ^{125}I activity was five to 10 times greater than that of ^{131}I activity. Diagnostic lymphangiography does not significantly affect retention of oil injected during the second study. (auth)

32113 EXAMINATION OF THE BRAIN AND LIVER BY ^{99m}Tc. INITIAL RESULTS. Cheguillaume, J.; Malinowski, A.; Robillard, J.; Minier, J.; Bloquel, J. (Centre Anticancereux, Angers, France). Rev. Med. Liege; 23: Suppl. No. 1, 77-84(Oct 1968). (In French).

The use of ^{99m}Tc in brain and liver scintigraphy was discussed and compared with other radioisotopes. Blocking of the gastric mucosa and thyroid by pretreatment with perchlorate ion improved results obtained in brain and liver scans. The advantages of ^{99m}Tc were simplicity of use, high counting rates which improved contrast, rapid removal from tissues, low irradiation dose, and collimation that provided good definition. Disadvantages of ^{99m}Tc were that delayed studies were not feasible, and the possibility of salivary contamination, which could produce undesirable artifacts in the scan. This could be avoided by use of 1 mg of atropine. The whole-body irradiation dose from 10 mCi of ^{99m}Tc was 0.12 rad, as compared to 0.72 rad for 375 μCi of ^{131}I-labeled human serum albumin, and 0.46 and 0.09 rad from 750 μCi of ^{203}Hg or ^{197}Hg, respectively. Corresponding irradiation doses from these radioisotopes to the critical organs, gastric mucosa, blood, and kidney were 2.5, 1, 100, and 4 rad, respectively. The irradiation doses from ^{99m}Tc-sulfide and colloidal ^{198}Au used in liver scanning were compared. With a dose of 3 mCi of ^{99m}Tc-sulfide the absorbed irradiation dose to liver, spleen, bone marrow, male and female gonads, and whole-body were 0.72 to 0.99, 0.48 to 1.3, 0.07 to 0.10, 0.07, 0.04, and 0.05 rad, respectively. For 300 μCi of colloidal ^{198}Au, the corresponding irradiation doses were 7.8 to 12.8, 7.4 to 22, 0.8 to 2.2, 0.18, 0.12, and 0.7 rad, respectively. As compared in terms of their practical use, ^{99m}Tc-sulfide was superior to colloidal ^{198}Au because its preparation was simple, the scan image had greater resolution, the ^{99m}Tc left the tissue more rapidly than the ^{198}Au, superficial lesions were more detectable and detection of deep lesions was possible, and statistical counting accuracy was greater with lower irradiation dose to liver, spleen, and bone marrow. (BBB)

32114 THE USE OF HUMAN SERUM ALBUMIN LABELED WITH ^{99m}Tc IN PLACENTAL AND PULMONARY SCINTIGRAPHY. Paulin, R.; Briand, C.; Bernard, P. J. (Univ. d'Aix-Marseille). Rev. Med. Liege; 23: Suppl. No. 1, 69-72(Oct 1968). (In French).

The advantages of the use of ^{99m}Tc-labeled human serum albumin for placental and pulmonary scintigraphy were discussed. The chief advantages of ^{99m}Tc included its short, 6-hr half-life and low radiotoxicity, the ease of measurement of its monoenergetic γ radiation, and the fact that ^{99m}Tc did not emit β radiation. Methods for preparation of ^{99m}Tc-labeled albumin were described and compared. The labeling procedure used was based on the presence of trivalent Fe and ascorbic acid. The solutions used and the methods of labeling and purification were described briefly. It was possible to label the albumin with ^{99m}Tc at 96 to 98% efficiency. In placental studies it was found that the concentration of ^{99m}Tc in cord blood never exceeded that in the maternal blood by more than 4%. The intravenous dose of ^{99m}Tc-labeled human serum albumin used amounted to 700 μCi. Aerosols of this material were used for pulmonary scintigraphy in place of ^{198}Au aerosols. The quality of the scans obtained was closely comparable to the ^{198}Au scans. The advantage of ^{99m}Tc scans for pulmonary scintigraphy was that the irradiation dose was about $^{1}/_{40}$ of the dose from a ^{198}Au pulmonary scan. (BBB)

32115 A KIT FOR PREPARATION OF HIGH SPECIFIC-ACTIVITY ^{99m}Tc ALBUMIN FOR CISTERNOGRAPHY AND BLOOD-POOL IMAGING. Cooper, James F.; Stern, Howard S.; Deland, Frank H. (Johns Hopkins Medical Institutions, Baltimore). Radiology; 95: 533-7(Jun 1970).

A four-unit kit, pretested for stability, chemical composition, sterility, pyrogenicity, clarity, biological distribution, and safety, was used routinely to prepare sterile, high specific-activity ^{99m}Tc albumin in less than thirty minutes. With use of binding efficiency of the reaction as the indicator, a preclinical stability study of the sodium-ascorbate and ferrous-iron mixture showed sufficient stability to yield acceptable binding efficiencies for a two-month period; other components are given a three-month expiration date. In cisternography and scanning, no adverse effects related to the use of this kit have been observed. (auth)

Radiotherapy

Refer also to abstracts 31939, 31986–31997, 31999, 32000, 32006, 32009, 32010, 32015, 32019, 32056, 32209, 32232, 32241–32244, 32247, 32249–32252, 32254, 32257, 32260, and 32262.

32116 EXPERIENCE WITH A REMOTELY CONNECTED TIME-SHARING COMPUTER TERMINAL. Cunningham, J. R.; Bruce, W. R. (Ontario Cancer Inst., Toronto). pp 131-3 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670730.

The Ontario Cancer Institute uses a teletype terminal connected by telephone line to a General Electric time-sharing computer system. New programs can be written and stored for use, or programs may be called from the system's library. At least three programming languages are available (FORTRAN, ALGOL, and BASIC). The system is ideal for programming since turn-around and diagnostic comments are virtually instantaneous. The system

is available on a monthly rental basis which includes the rent of teletype, telephone line, twenty-five hours connection time, two hours of central processor time, and a dedicated storage of 60,000 characters. The terminal has been used for routine medical physics calculations such as the calculation of radiation dosages, analyses of results of nuclear medicine tests, in biological research, physics research, and as a teaching tool. (auth)

32117 COMPUTER INTERFACE, INPUT METHODS, AND PRESENTATION OF RESULTS. **Sterling, T. D. (Washington Univ., St. Louis).** pp 135-41 of Role of Computers in Radiotherapy. Vienna, International Atomic Energy Agency, 1967.

From Panel on the Role of Computers in Radiotherapy, Vienna, Austria. See STI/PUB-203; CONF-670736.

Planning radiation treatment consists of a long chain of events in which the computer may enter at almost every link. There are therefore many places where easy communication must be developed between the computer and the job to be performed. Automation and instrumentation have reached a point today where this interface problem can be discussed with profit, and many solutions among alternative ones become possible. As treatment-planning programs become more sophisticated and can account for the effects of patient curvature and heterogeneity, it becomes more and more cumbersome to provide the computer with necessary information as to how the patient is constituted and where the tumor is located. The simplest solution to developing the necessary information for the computer is to use transducing devices which have the ability to translate the necessary graphic information into some digital format. Such a transducing device can be drawn along the contours of the patient or along contours sketched on a plan and convert information concerning patient curvature and outline of internal organs into the coordinate system which is needed as input. The development of three-dimensional output that can actually be displayed as a three-dimensional picture is made possible through holography although the expense involved would seem to make this process impractical. High-speed printers are still the best method of presenting many slices through a three-dimensional volume. Some measure of immediate control over treatment planning could be developed through a type of on-line simulation aided by computers. A part of the interface problem lies in creating the software needed for optimum utilization. Some of the components of this interface are necessary mathematical skills, knowledge about computers in sophisticated detail, and engineering facility for on-line instrumentation. This means that knowledge of technical personnel and therapists has to be redefined or additional individuals added to the therapy team. (11 references.) (auth)

32118 CURRENT EXPERIENCES AND CONCEPTS ON INDUCTION OF OVULATION. 3. INDUCTION OF OVULATION USING X-RAYS. **Limon, Jose Noriega.** Gac. Med. Mex., 97: 801-5(July 1967). (In Spanish).

X-radiation treatment of ovary dysfunction and of sterility due to lack of ovulation is still practiced, but because of possible genetic hazards it is only applied when chemical and hormonal methods fail. The results are satisfactory. Forty-two cases in which radiation treatment was made exclusively to remedy anovulatory sterility are reported. The hypophysis was irradiated with a total dose of 100 rad over a period of 3 weeks, the ovaries with 30 to 50 rad during the same time. Before starting irradiation it is necessary to establish that no pregnancy exists and sexual abstention is imperative from the start of the treatment until after the third menstruation following termination to avoid death or deformation of a fertilized ovum. The mechanism of action of radiation in the induction of ovulation is not known, but it is assumed that irradiation of the hypophysis releases gonadotrophic hormones, while irradiation of the ovaries facilitates normal estradiol metabolism. A danger of transcendental importance consists in a possible damage of the germinal epithelium and for this reason x-ray treatment to induce ovulation is still a matter of dispute. Opponents of x-ray treatment maintain that genetic damage may occur due to cumulative point mutations which eventually may become dominant and show up in the first or any succeeding generation. The existence of a dose threshold for genetic damage in humans is unknown. The supporters of x-ray treatment are in agreement that its effect is a high rate of pregnancies of formerly sterile women. Among the 42 irradiated women, 15 became pregnant, 9 remained sterile, and for 18 the result could not be ascertained since no further contact with these women could be established. (F.J.W.) (TSS)

32119 INTERSTITIAL PROTRACTED LONG-TERM IRRADIATION OF HYPOPHYSEAL ADENOMAS BY MEANS OF STEREOTAXIC IMPLANTATION OF ^{192}Ir. **Mundinger, F. (Univ., Freiburg i. B.).** Acta Radiol., Ther., Phys., Biol.: 8: No. 1-2, 55-62(Feb-Apr 1969). (In German).

The results of treatment by permanent stereotaxic intrasellar, implantation of ^{192}Ir in 50 patients with chromophobe and eosinophil adenomas are reported. It could be ascertained, on the basis of follow-up periods of up to 5.8 years, that this type of protracted irradiation was significantly superior as compared with the intrasellar implantations of radiophosphorus and radiogold in the 131 cases earlier reported upon. All the patients except one are alive and no clinical or endocrine signs of recurrence have been observed. (auth)

32120 PREOPERATIVE RADIOTHERAPY OF CANCER OF THE UTERINE CERVIX AND RADIOSENSITIVITY TEST WITH ^{3}H-THYMIDINE. **Watanabe, Eiichi; Kawakami, Masao (Kyushu Univ., Fukuoka).** Sanfujinka No Jissai; 18: 657-65(Jul 1969). (In Japanese).

The data on 25 patients with cancer of the uterine cervix treated with preoperative ^{60}Co teletherapy and radium since 1966 are reviewed to study the potential value of single radiotherapy of uterine cervix cancer. The treatment plan was to deliver tumor doses of 4000 R of ^{60}Co and 4000 to 6000 mgh of radium which in total equaled 70 to 80% of single radiotherapy dosage. Surgery was performed in 2 to 5 weeks following irradiation. An increased hemorrhage during surgery and rather unfavorable postoperative course including delayed recovery of the urinary bladder function were noted. On the other hand, the incidence of metastasis was lower compared with the control group; 16.0% of the cases and 1.7% of the total lymph nodes examined in contrast to 24.1% and 2.7% of the unirradiated cases. Radiosensitivity tests of tumor tissue using microautoradiography with ^{3}H-thymidine, ^{3}H-cytidine and ^{3}H-uridine are discussed. The potential use of single radiotherapy for the treatment of uterine cervix cancer with high radiosensitivity was suggested provided a feasible test method is established. (NSA of Japan)

32121 TOURNIQUET TECHNIQUE IN RADIOTHERAPY OF LIMB TUMORS. **van den Brenk, H. A. S. (St. Thomas' Hospital, London).** Nunt. Radiol.; 34: 207-14(Mar 1968).

Techniques used in clinical radiotherapy to offset tumor radioresistance, attributable to tumor anoxia or severe hypoxia, which must be employed to either reverse the tumor anoxia (i.e., hyperbaric oxygen) or allow an increased dose, sufficient to kill anoxic tumor cells, are discussed. The latter method requires that doses be raised 2.5 to 3 fold, that will be tolerated by the normal tissues because these tissues are also made anoxic. The tourniquet anoxia technique used to produce this dual effect, a regional anoxia or severe hypoxia of both tumor and associated normal tissue, is explained. Results of the tourniquet method of circulatory arrest for the irradiation of limb tumors under severe hypoxia are reported, together with fractionated dose schedules, based on cell survival theory. The results obtained were better in soft-tissue tumors than in medullary bone sarcoma. This difference is largely attributable to the fact that normal bone tolerates radical irradiation therapy much better than bone already disorganized and destroyed by neoplastic involvement. A high percentage of bone sarcomas, in particular, recur following irradiation even if the tourniquet technique is used to offset radioresistance attributable to tumor anoxia. Some biological reasons for this finding are discussed. The cells of such tumors may be radioresistant for reasons other than the oxygen effect. Another explanation is that in this type of tumor the nontumor cell population is too large and a relatively higher proportion of tumor cells may have stem cell properties and the intrinsic capacity to proliferate and clone and thus cause recurrence. The maximum radiation dose that can be safely given under anoxic conditions are inadequate in reducing cell survival to near zero levels. (BBB)

32122 COMPENDIUM OF REPORTED HUMAN BONE MARROW TRANSPLANTS. **Bortin, Mortimer M. (Mount Sinai Hospital, Milwaukee. Marquette Univ., Milwaukee).** Transplantation; 9: 571-87(Jun 1970).

A summary of 203 reported human bone marrow transplants is presented. The transplants were made between 1939 and 1969 and the cases are divided into four categories: aplastic anemia; leukemia; malignant disease and miscellaneous conditions; and immune deficiency disease. Data are tabulated for each patient as to etiology, sex, age, pretreatment, type of donor, cell dose, survival time, and proof of chimerism. Total body radiation was administered as pretreatment in many cases of leukemia, malignant, and other diseases. During the past year the treatment of immune deficiency disease with bone marrow transplants was strikingly successful. (H.L.W.)

32123 RADIOBIOLOGICAL CONTRIBUTIONS TO THE THERAPY OF MALIGNANT TUMORS. **Hug, O. (Univ., Munich).** Z. Laryngol., Rhinol., Otol.; 46: 325-37(May 1967). (In German).

Reviewed are radiation effects on tissue cultures, biological effectiveness of the various types of electromagnetic and ionizing radiations, recovery processes during fractionated exposures, oxygen effect, and radiation injury to rapidly proliferating tissues. The findings are applied to radiation treatment of malignant tumors in animals. After injection of thymidine labeled with tritium or carbon-14, high activity is found predominantly in the peripheral region of the tumor and in the vicinity of blood vessels. Other parts of the tumor show little or no activity. When fractionated doses are given, the effective accumulated dose is more important than the actual accumulated dose because of the recovery between exposures. Methods for estimating the effective dose and their importance for clinical radiotherapy are outlined. (H.B.G.)

32124 PROTECTIVE TREATMENT OF THE LIVER DURING ^{60}Co IRRADIATION FOR LIVER METASTASES. Kleinert, H. (Univ., Heidelberg). Ther. Gegenw.; 107: 1648-53(1968). (In German).

Objective assessment of the efficacy of treatment in diseases of the liver remains a difficult and problematic matter. Clinical observations were made concerning subjective and objective improvement in 12 patients with hepatic metastases who in the course of conventional treatment were also given Hepamerz (ornithine aspartate, adenosine triphosphoric acid, vitamins, N acetyl DL homocysteine thiolactone, and pancreatin). From the results it is concluded that cancer patients with hepatic metastases treated by irradiation have a better chance of survival if the detoxicating capacity of the liver is stimulated. Such hepatoprotective treatment is of particular importance in radiotherapy, in view of the toxic integration products with which the liver has to cope during this treatment. This report concerns only a limited number of patients, and no control groups were studied. (Excerpta Med.)

32125 CHANGES IN LUNG PARENCHYMA FOLLOWING BETATRON X-RAY THERAPY. Janousek, Z.; Skrivanek, O.; Chvojka, Z. (Karlovy Univ., Hradec Kralove, Czech.). Cesk. Radiol.; 21: 330-5(Sep 1967). (In Czech).

Among 32 patients receiving irradiation for malignant tumors in the chest by means of betatron x rays, with a maximal photon energy of 15 MeV, postirradiation changes in the lung parenchyma developed in 11 cases. The isodose distribution factors and the techniques used for irradiation are described in detail. The dose schedules employed usually called for 6000 R given over 30 to 60 days, but 1 patient showed lung injury after a total dose of 2500 R fractionated over 15 days. The single daily doses varied from 290 to 340 R. The largest dose given (to only 1 patient) was 7000 R extended over 64 days. In a few cases symptoms of pneumonia were noted after doses of 1500 to 4000 R had been reached. Pulmonary fibrosis developed in these 11 patients from 1 to 5 months postirradiation. Radiographs of the fibrotic lungs are illustrated. It is suggested that even though some of the more obvious physical factors might explain the origin of the postirradiation changes in the lungs, the decisive factor is probably the present insufficient knowledge concerning the actual physical conditions and the relative biological action of betatron x rays on the lung parenchyma, as well as the magnitude of the integral dose. The changes observed were definitely more frequent and more pronounced than the lung changes accompanying deep x-ray therapy or ^{60}Co treatment that have been previously observed. (BBB)

32126 POSTIRRADIATION SURGERY FOR BRONCHOGENIC CARCINOMA. Smith, Lawrence; Parnsingha, T. (Auckland Hospital, N. Z.). Thorax; 24: 457-60(Jul 1969).

Complications that resulted from irradiation in an attempt to improve both the resectability and survival rates for bronchogenic carcinoma by preoperative supervoltage radiotherapy are reported. An estimated tumor dose of 4500 R was delivered by daily fractions over 4 weeks, using supervoltage therapy (4 MeV). The fields included the primary tumor and the important lymph drainage areas. After an interval of 2 months, resection and whenever possible a lobectomy was performed. In the postirradiation surgical group of 58 patients there were 9 hospital deaths, 4 directly attributable to bronchopleural fistulae, 2 were due to massive pulmonary embolism, and 1 each to cardiac arrhythmia, pneumonia, and myocardial radionecrosis. Nine (15.5%) developed bronchopleural fistulas. All of these patients eventually died. Usually the fistulas occurred before the fourth week, but on occasions the onset was delayed several months. No bronchopleural fistulas occurred in the nonirradiated surgical group. Radionecrosis of the myocardium, leading to fatal operative hemorrhage, occurred once. The supervoltage therapy made tissues thicker than normal during the hilar dissection but this did not make the operation more difficult. The bronchopleural fistula rate of 15.5% among the irradiated group is high and compares unfavorably with a 1.5% incidence in a large group of cases after surgery alone and the 1.6% incidence obtained in this hospital before the introduction of preoperative radiotherapy. This high incidence is attributed to impaired tissue healing and lowered tissue resistance resulting from radiotherapy. The single case of radiation damage to the myocardium encountered seemed an uncommon complication. Supervoltage radiotherapy has a profound effect on the primary tumor and the hilar and mediastinal lymph node metastases; 25% of the lung specimens and lymph nodes had been sterilized by radiotherapy. However, there was a 3-yr survival of only 15.7%. The combined treatment of supervoltage therapy plus surgery produced worse results than expected from surgery alone, due to the complications of radiotherapy. (BBB)

32127 SOME OBSERVATIONS IN RADIONECROSIS OF THE JAW. Hatjifotiades, D.; Eleftheriades, J.; Papadimitriou, P. Stomatologia (Athens); 26: 123-34(May-Jun 1969). (In Greek).

Prophylactic measures for secondary effects of oral radiotherapy include: postponement of postsurgical irradiation for one year; extraction of teeth in the area to be exposed; avoidance of intra-oral and extra-oral surgery in patients with extensive jaw necrosis; and high levels of oral hygiene throughout the exposure period. (H.G.D.)

32128 RADIOACTIVE RESIN MICROSPHERES IN THE TREATMENT OF RENAL TUMOURS: PRELIMINARY REPORT, WITH A DESCRIPTION OF 7 PERSONAL CASES. de Nunno, R. Jr.; Botta, G. C.; Prestipino, F.; Pipino, G. (Univ., Milan). Panminerva Med.; 11: 460-9(Oct 1969).

First results from the use of radioactive resin microspheres, followed by anterior transperitoneal excision, in tumors of the kidney are reported. Surgery was performed at different times after the radioisotope treatment to investigate the possibility of using such treatment as routine preoperative management, so as to cut down the risk of surgically induced metastasis, and to study the effect of continuous heavy irradiation on the healthy parenchyma. The technique is described and histological pictures of both the healthy and neoplastic areas are illustrated. Discussion of the results leads to the suggestion that further experience will show whether the method should be reserved for inoperable cases, or may in fact be employed as a systematic preoperative procedure. (auth)

32129 ON THE USE OF ANTINEOPLASTIC ANTIBIOTICS IN THE COMBINED THERAPY OF MELANOMA METASTASES. Zolotkov, A. G. Antibiotiki; 14: 651-6(Jan 1969). (In Russian).

Thirty-four cases with melanoma metastases to the lymphatic nodules and skin were treated with local irradiation and antitumor antibiotics, such as olivomycin, chrysomallin, and aurantin. Chrysomallin and aurantin, compounds close by their composition to actinomycins C and D, had a more pronounced therapeutic effect. Olivomycin did not increase skin radiation reactions, while chrysomallin and aurantin did increase them. Administration of every antibiotic was accompanied by certain symptoms of general intoxication, which were more pronounced with the use of olivomycin. Slight hematological changes were observed with the use of chrysomallin and olivomycin. Aurantin induced no hematological changes. The above side effects did not usually prevent the use of complete combined treatment course. (auth)

32130 RADIOTHERAPY WITH BETATRON-ACCELERATED ELECTRONS. Loasses, A. (Univ., Rome). Radiol. Med.; 55: 970-92(Oct 1969). (In Italian).

Analysis of the interaction between accelerated electrons and matter and studies of their biological effectiveness suggest that no substantial difference exists with respect to the clinical use of this type of radiation as opposed to conventional forms. The improved course of cases treated with accelerated electrons is to be attributed not so much to a quantitatively different action in the biological sense as to the technical irradiation conditions offered by electrons in the management of neoplastic sites. A betatron giving 6 to 15 MeV electron beams has been in use in the Department of Radiology of the University of Rome since 1957. Clinical and statistical analysis of its employment in the management of various types of neoplasms confirms what has already been reported on many occasions, namely that the results achieved are virtually similar to those offered by conventional types of radiation. This finding, however, does not diminish the undoubted technical advantages offered by the therapeutic use of accelerated electron radiations. (auth)

32131 EXPERIENCE WITH RADIOTHERAPY OF MALIGNANT GERMINAL TUMORS OF THE TESTES. Schreyer, Herbert (Univ., Graz). Strahlentherapie; 138: 522-9(Nov 1969). (In German).

This report concerns 51 cases of malignant germinative tumors treated by radiotherapy between 1954 and 1967. Radiotherapy was mostly preceded by an enlarged semicastration. In a few cases

retroperitoneal lymphadenectomy was carried out. Seminomas have the best prognosis, even when metastases are present in the regional lymph nodes. Survival results for malignant testicular tumors are good, when no metastases are found in the regional lymph nodes at the beginning of treatment. When these are present, distant metastases are probably existing, which cannot be detected by clinical or radiological explorations. The value of systematic radiotherapy of the lymph node region is stressed. A case of recurrence of seminomas after 24 years is reported. Telecobalt therapy is superior to orthovoltage for the irradiation of the lymphatics. (auth)

32132 INDICATIONS FOR X-RAY THERAPY (180 TO 300 kV) AS COMPARED TO MEGAVOLT THERAPY. Scherer, Eberhard; Rassow, Juergen (Ruhr Univ., Bochum, Ger.). Strahlentherapie; 138: 513-21(Nov 1969). (In German).

The present indications for orthovoltage radiotherapy are discussed and tabulated. Except for a few indications all diseases should be treated by megavoltage radiations. Moving beam techniques still have some possibilities. Systemic and benign diseases could be treated by conventional radiotherapy, but telecurie apparatus can do it as well. A cesium apparatus has distinct advantages for medium-sized hospital and private practice, based on personal experience of seven years. (auth)

32133 SCAN EVIDENCE OF HEPATIC "REFUNCTION" AFTER TUMOR IRRADIATION. Spencer, Richard P.; Kligerman, Morton M. (Yale Univ., New Haven). J. Nucl. Med.; 11: 140-1 (Mar 1970).

Hepatic scans have shown that following therapeutic irradiation of part of the liver temporary or permanent impairment of function of the region can occur. A diametrically opposed situation is described: namely the x irradiation of a nonfunctioning tumor in or near the liver (that is, one without the ability to take up ^{198}Au), followed by the appearance of functional tissue in the region. It is suggested that regression of the lesion permits reexpansion of normal hepatic tissue. (auth)

32134 EXTRACORPOREAL IRRADIATION FOR ACUTE LEUKEMIA. Denman, A. M.; Greaves, M. F.; Denman, Evelyn J. (Karolinska Institutet, Stockholm). Lancet; 2: 494(30 Aug 1969).

Some previous observations on the effects of extracorporeal irradiation in acute leukemia are commented upon and discussed in relation to another biological problem of current interest. It was previously noted that when part of a tissue is subject to injury, the other part, containing proliferative cells, does not remain stable, exchange passively, and allow itself to be depleted. The effects of antilymphocytic globulin (ALG) are in many ways analogous to those of extracorporeal irradiation, for here also lymphocytes are lysed or opsonized in the periphery while the central lymphoid cells are relatively protected from direct inactivation. It has been suggested that increased proliferative changes in the lymphoid tissues are secondary to immunization by heterologous protein, and are irrelevant to the immunosuppressive action of ALG, but there are reasons for doubting this view. The complex changes that occur centrally in the face of the continued peripheral destruction of lymphocytes are probably not only relevant to the immunosuppressive effects of ALG; they may also have a bearing on the oncogenic risks of treatment with ALG. Virus replication might well be enhanced in abnormally proliferating lymphoid cells in vivo in the same way as such replication is enhanced in lymphocyte cultures treated with ALG in vitro. (BBB)

32135 TREATMENT WITH NEUTRONS. Brit. Med. J.; 4: 381-2(15 Nov 1969).

Introduction of neutron irradiation in the treatment of neoplasms at several radiotherapy centers is reviewed briefly. In penetrating power the neutrons to be used for cancer therapy are comparable with 250 kV x rays, but their potential efficacy depends on other factors. Anoxic cells, which may exist in the center of a tumor, are resistant to damage by radiation, but the protective effect of cellular anoxia is less with neutrons than with x rays. It is for this reason that neutron therapy is now being studied. The technical problems are formidable but appear to be soluble. Some unsolved biological problems remain. Small early tumors are probably adequately nourished and unlikely to contain anoxic cells. A tumor large enough to have an anoxic core may already have initiated metastatic spread and be beyond the reach of effective treatment by local irradiation. It is possible that anoxic cells are destroyed to some extent by existing techniques with high-energy x rays. The total radiation dose is usually delivered in daily fractions over a period of 3 to 4 weeks. The treatment does more than merely incapacitate adequately oxygenated malignant cells. After each fractional dose of radiation some anoxic cells become reoxygenated and become more sensitive to subsequent attack. In these circumstances the correct fractionation regimen required for neutron therapy remains to be established by further experiment. (BBB)

32136 IRRADIATION TWENTY-FOUR HOURS PREOPERATIVELY. Ketcham, Alfred S.; Hoye, Robert C.; Chretien, Paul B.; Brace, Kirkland C. (National Cancer Inst., Bethesda, Md.). Amer. J. Surg.; 118: 691-7(Nov 1969).

This clinical report is the result of a study that was based on an experimental in vivo protocol using five separate transplantable tumor host systems in which 715- to 2000-R doses of x rays were administered to each of the five different primary tumors. Twenty-four hr after irradiation the tumors were excised and their cell suspensions artificially disseminated into the vascular system or into open, fresh surgical wounds of genetically compatible animals. The subsequent tumor growth, either locally in the wound or as evidenced by metastasis, was reduced from 100% in control animals to less than 2% in the treatment groups. This laboratory study led to the combined use of irradiation and surgery in the treatment of head and neck tumors in which the incidence of local recurrence is high and that of metastasis is frequent. With a single 2000- or 1500-R dose of 2-MeV x rays 24 hr before surgery, there was a high incidence of complications. Seventy-nine patients were then studied in a carefully controlled double-blind study using 1000 R preoperatively. All lesions were squamous cell cancers of the oral pharyngolaryngeal area and were excised by standard surgical procedures. The postoperative complications were significantly increased in the patients with irradiation. Although there was a definite trend toward the decrease of local recurrence with preoperative irradiation, there was no statistically significant decrease in the local recurrence rate in the operative wound, nor was there any tendency toward the decrease in incidence of metastases; neither was patient survival prolonged. Tumors in human subjects thus do not necessarily behave as expected on the basis of studies of experimental tumor systems.(BBB)

32137 THREE-YEAR OBSERVATION OF COMBINED TREATMENT FOR FAR ADVANCED CANCER OF THE HEAD AND NECK. Lipshutz, Herbert; Lerner, Harvey (Pennsylvania Hospital, Philadelphia). Amer. J. Surg.; 118: 698-700(Nov 1969).

Synergistic effects of radiotherapy and chemotherapy were evaluated in 60 patients. Hydroxyurea was administered as a single oral dose of 80 mg/kg of body weight every third day. The first week after hydroxyurea had been instituted, radiation was begun (1-MeV source) and given 3 times a week for 6 to 10 weeks (200 to 300 R each treatment) to a full therapeutic dosage of 6000 to 6500 R. The hydroxyurea was continued throughout the period of irradiation treatment and indefinitely thereafter. Mucositis and radiodermatitis frequently occurred within 2 weeks of radiotherapy. Actual breakdown of the skin was seen even after small doses of x rays. These reactions were controlled by local therapy to the skin for symptomatic relief, and the use of local anesthetics to the mucous membrane. In some patients x-ray treatment was temporarily discontinued because of the severe local reaction. However, as the treatment continued, the mucositis in most patients gradually subsided. There was an overall survival rate of 50% or thirty patients who are alive and well in periods ranging from 4 to 44 months after treatment. Twenty-three patients have survived 18 months or more. In the treatment of epidermoid carcinoma of the head and neck, the combined use of hydroxurea and irradiation appears to be more effective than is either alone. The action of hydroxyurea on cancer cells may be one of destruction of relatively radioresistant cells in the S stage and a synchronization of the other cells in a relatively radiosensitive stage (G_1), permitting the radiation to be more effective than it would ordinarily have been.(BBB)

32138 ELECTRON-BEAM TECHNIQUE AND SKIN REACTION OF POSTOPERATIVE IRRADIATION OF AXILLA AND SUPRACLAVICULAR NODES IN BREAST CARCINOMA. Khan, F. R.; Bohorquez, J. F.; Ovadia, J.; Nickson, J. J. (Michael Reese Hospital, Chicago). Radiology; 95: 417-20(May 1970).

Irradiation of the axillary, supraclavicular, and internal mammary lymph nodes has been carried out in 36 patients over a 2-year period. A technique of enbloc irradiation of the axilla and supraclavicular regions combines electrons of two widely different energies. The tolerance of these regions is described and compared with that of the internal mammary areas. A time-dose schedule presented for treatment of these areas produces the least reaction and discomfort and seems equally effective in controlling microscopic disease. Acute reactions of skin from electron therapy heal quickly, with minimal late changes. (auth)

Blast and Thermal Effects

32139 LEUKEMIA IN ATOMIC BOMB SURVIVORS: HIROSHIMA, 1946–1967. Hirose, Fumio (Hiroshima Univ.). Nippon Ketsueki Gakkai Zasshi; 43: 765-71(Oct 1968). (In Japanese).

Results of statistical studies of leukemia in persons exposed to

the atomic bomb (within 5000 m of the hypocenter) in Hiroshima from 1946 to 1967 are summarized. Of 168 cases of leukemia, 68 cases included chronic myeloid leukemia that developed in the atomic bomb survivors in Hiroshima City from 1946 to 1967. The incidence per 100,000/yr was 8.34. It maintained a high level from 1951 to 1959 but thereafter showed a gradual decrease. There were 153 deaths from leukemia in the survivors during the past 22 years. The death rate, 7.63 per 100,000/yr, was about 3.6 times that of the 2.14 rate of the nonexposed subjects and about 3.3 times that of the 2.32 rate for all Japan. Leukemia incidence was high in persons exposed within 2000 m and low in survivors exposed beyond 2000 m distance. According to the population exposed on the basis of the 1960 census, the incidence in survivors exposed at the distance 3001 to 5000 m was 4.04, considered a high incidence. Of the 168 exposed cases, there were 70 with chronic and 98 with acute types of leukemia. The ratio of chronic to acute type cases was highest during the years 1951 to 1955, and thereafter tended to decrease, but the ratio during the years 1966 to 1967 was considerably higher than that for all Japan, and a high incidence of chronic leukemia was noted in the exposed cases. The ratio of the chronic to acute type decreased with increase in the distance from the hypocenter, but the ratio for cases from 3001 to 5000 m was higher than that of all Japan. The survival period for leukemics exposed within 2000 m was longer than those exposed beyond 2000 m and it is believed that the survival period may be longer than that of the nonexposed subjects with leukemia. There have been 63 cases of leukemia in the early entrants (persons who entered Hiroshima City soon after the atomic bomb explosion) since 1950. The incidence of 45 cases among persons who entered within 3 days after the explosion was high (9.69), and 24 of these cases were of the chronic myeloid type. (BBB)

32140 LEUKEMIA IN SURVIVORS OF THE ATOMIC BOMBING. II. NAGASAKI. Ichimaru, Michito (Nagasaki Univ.). Nippon Ketsueki Gakkai Zasshi; 43: 772-83(Oct 1968). (In Japanese).

Various statistical analyses were performed for 583 cases of proven leukemia in Nagasaki from Sept. 1945 to the end of 1967. The relation between the incidence of the leukemia and the estimated radiation dose was studied. The blood smears of 26 cases of acute leukemia in proximally exposed survivors, 33 cases of acute leukemia in distally exposed survivors, and 32 cases of acute leukemia in nonexposed persons are reviewed. The incidence of the leukemia probably due to atomic bomb radiation had decreased, but 2 or 3 cases a year are still being discovered, and it is suggested that observations on Nagasaki leukemia cases should be continued. In Nagasaki the sensitivity to atomic bomb radiation as concerns leukemia seems to be higher in the younger age group than in older ones both in acute and chronic granulocytic types. It is thought that the development of atomic bomb-induced leukemia in persons that were young at the time of the bombing has already ceased. Development of leukemia in the younger age group may have been earlier than in the older age group. In Nagasaki the relation between the radiation dose and the incidence of leukemia is linear in the groups that received higher doses, but there is no increase in the incidence of leukemia in the low dose range (20 to 100 rad), so that the existence of a threshold is suspected. The existence of few cases of aleukemic leukemia resembling aplastic anemia clinically and pathologically in the second period (1950 to 1955) was noted and the mild atypical adult acute leukemias were characteristic for the proximal survivors. Atomic bomb irradiation may induce both types of acute leukemias, granulocytic and lymphatic, and the relatively high incidence of peroxidase-negative and undifferentiated types (stem-cell leukemia?) seems to be characteristic of acute leukemia in proximally exposed survivors. (BBB)

32141 ABERRANT KARYOTYPES AND SPONTANEOUS ABORTION IN A JAPANESE FAMILY. Kadotani, T. (Hiroshima Univ.); Ohama, K.; Sofumi, T.; Hamilton, H. B. Nature (London); 225: 735-7(21 Feb 1970).

The studies described were made in conjunction with the Japan Atomic Bomb Casualty Commission, Hiroshima. It was thought that chromosome aberrations involving trisomy, monosomy, and translocations may be aetiologically related to spontaneous abortion in humans, and studies are described of a family in which translocations seemed to be associated with repeated spontaneous abortions. (UK)

Radiation Effects on Animals

Refer also to abstracts 31808, 31854, 31903, 31926, 32039, 32048, and 32283.

32142 (ANL-7489, pp 13-19) DIVISION DELAY AND RECOVERY IN IRRADIATED SEA URCHIN GAMETES. Failla, Patricia (Argonne National Lab., Ill.).

Recovery from ^{137}Cs γ radiation-induced cleavage delay was observed when the first cell division cycle is prolonged by a variety of agents. The results are discussed from the point of view of elucidating the nature of this recovery process. It is inferred that some sort of metabolic activity is required for the process to operate efficiently. (auth)

32143 (N-69-13276) [THE ROLE OF NUCLEOTIDE METABOLISM IN THE REPAIR OF RADIATION INJURY]. Final Progress Report, September 1966-September 1968. Dalrymple, Glenn V. (Arkansas Univ., Little Rock. Medical Center). 9p. CFSTI.

The radiation effects on DNA, polymerase, nucleases, and the survival properties of cells were investigated under conditions of normal growth, DNP-treatment, and starvation. To study DNA synthesis, pulse and continuous labeling with ^{32}P was used in irradiated cells. Cells in growth medium showed no difference in ^{32}P labeling from non-irradiated control cells. Starved and DNP-treated cells showed discrete periods of accelerated labeling of DNA and RNA. No evidence of DNA degradation was found eight hours postirradiation in cells prelabeled with tritiated thymidine. It was found that radiation doses of 100 rads to 1000 rads did not alter polymerase or nuclease activities. Survival studies showed that DNP-treated cells had a significantly higher survival than cells in growth medium, and starved cells may have had a slightly higher survival than those in growth medium. A model is suggested that explains the repair process in terms of an enzyme that rejoins single-strand breaks in the DNA molecules. (STAR)

32144 (ORO-3884-2) [A RADIOLOGIC EVALUATION OF AN IN VITRO MAMMALIAN CELL RENEWAL SYSTEM]. [Annual] Progress Report, January 1-December 15, 1969. (Veterans Administration Hospital, Little Rock, Ark.). Contract AT(40-1)-3884. 28p. Dep. CFSTI.

Results of a series of experiments concerned with the problem of repair of x radiation injury by mammalian cells are discussed generally. It was suggested that plateau phase Chinese hamster cells manifested differences in response to radiation as compared to log phase cells; possibly the plateau phase cells showed a diminished ability to repair sublethal injury because the DNA responded differently to radiation than in the case of log growth cells. The rates of DNA rejoining were found to be different for cells in the different phases. Experiments with L cells were conducted to determine whether or not DNA synthesis was involved in the rejoining of DNA breaks; results showed that L cells were capable of rejoining DNA breaks. Publications that evolved from the research contract are listed. (C.O.)

32145 EFFECTS OF RADIATION ON ASYNCHRONOUS AND SYNCHRONIZED L CELLS UNDER ENERGY DEPRIVATION. Baker, Max L.; Dalrymple, Glenn V.; Sanders, J. L.; Moss, A. J. Jr. (Univ. of Arkansas, Little Rock. Veterans Administration Hospital, Little Rock, Ark.). Contract AT-(40-1)-2984. Radiat. Res.; 42: 320-30(May 1970).

The uncoupler of oxidative phosphorylation, 2,4-dinitrophenol (DNP) was shown to decrease the x-radiosensitivity of L cells in spite of producing a severe depression of DNA, RNA, protein, and ATP synthesis. Experiments were performed with other compounds that affect oxidative phosphorylation. These included studies with asynchronous L cells and with L cells synchronized by the double thymidine block technique. The results showed that two uncouplers of oxidative phosphorylation, arsenate and DNP, produced an increase in postirradiation survival. Two inhibitors of oxidative phosphorylation, azide and cyanide, although depressing macromolecular synthesis, caused no increase in postirradiation survival. Cyanide, in fact, produced a slight decrease in survival. Experiments with synchronized cells indicate that the effects of arsenate are chiefly exerted on cells in S phase, while the effects of DNP are distributed throughout the intermitotic interval. (auth)

32146 X-IRRADIATION OF BALB/3Te: SARCOMA-FORMING ABILITY AND VIRUS INDUCTION. Pollock, E. J.; Aaronson, A. A.; Todaro, G. J. (Bureau of Radiological Health, Rockville, Md.). Int. J. Radiat. Biol.; 17: 97-100(1970).

The effects of high doses of x radiation on the tissue culture properties and tumorigenicity of Balb/3T3 cells are described. This is a continuous line of highly contact-inhibited, non-tumorigenic cells derived from Balb/c mouse embryo cultures. The cell line Babl/3T3 can be transformed by the DNA-containing virus, SV40, and the RNA-containing murine sarcoma virus. In both cases the transformed cells lose contact inhibition of cell division, form multiple cell layers in culture and produce tumors when inoculated into Balb/c mice. It was shown that a single exposure to 1500 rads of x radiation produced a similar alteration of tissue culture properties, but the morphological changes were not so striking as those produced by SV40. Because survival at this dose was low, it was not possible to determine

whether the radiation acted directly to induce transformation or whether it selected a rare variant present in the initial population. (UK)

32147 RADIOSENSITIVITY OF THE COLONY-FORMING CELLS OF THE MOUSE BONE MARROW. Duplan, Jean F.; Feinendegen, Ludwig E. (Laboratoire Pasteur, Paris. Institut fuer Medizin, Juelich, Ger.). Proc. Soc. Exp. Biol. Med.; 134: 319-21(May 1970).

Using the tritiated thymidine suicide technique to identify the proportion of a cell population in S, the prior observation that colony-forming cells of adult mouse bone marrow are predominantly in a quiescent state (G_0) was confirmed. When bone marrow was assayed 24 hr after bleeding, up to 43% of colony-forming units had entered S but their overall radiosensitivity was unchanged. However, survivors of the thymidine suicide among CFC had a significantly lower radiosensitivity, indicating that the CFC in S are more radiosensitive than in G_0. Moreover, cells in either G_1 or G_2 must have a lessened radiosensitivity to account for the maintenance of an unchanged D_0 of the cell population that had entered the multiplication cycle following bleeding and from which cells in S had not been eliminated. (auth)

32148 LOCALIZED INCORPORATION OF THYMIDINE AFTER ULTRAVIOLET MICROIRRADIATION OF THE NUCLEUS. Moreno, Giuliana (Institut National de la Sante et de la Recherche Medicale, Kremlin-Bicetre, France. Compt. Rend., Ser. D.; 270: 988-9(16 Feb 1970). (In French).

Partial irradiations of the nucleus were carried out on K.B. cells. An incorporation of tritiated thymidine was observed restricted in certain cases to the irradiation area. It probably corresponds to a repair of the irradiated DNA. (France)

32149 EFFECTS OF IRRADIATION ON THE CELL CYCLE OF AN EXPERIMENTAL ASCITES TUMOUR OF THE MOUSE. Frindel, E.; Vassort, F.; Tubiana, M. (Institut Gustave-Roussy, Villejuif, France). Int. J. Radiat. Biol.; 17: 329-37(1970).

The parameters of growth kinetics of an experimental ascites tumor were measured at different times after irradiation with 250 rads. These parameters were studied in young, fast-growing tumors and in older, slow-growing tumors. After irradiation, the duration of G_2 is lengthened in the old tumors and unchanged in the young ones. In the younger tumors, there is an accumulation of cells in G_1, whereas in the older tumors, the accumulation of cells is mostly in G_2. The duration of the cell cycle is lengthened after irradiation in the young tumors, but this effect seems to be reversible. It seems also lengthened in the old tumors, but it is impossible with our data to calculate in this case the duration of the cell cycle. (auth) (UK)

32150 VARIATIONS OF CELLULAR SULFHYDRYL CONTENT DURING CELL CYCLE OF HeLa CELLS AND ITS CORRELATION TO CYCLIC CHANGE OF X-RAY SENSITIVITY. Ohara, H.; Terasima, T. (National Inst. of Radiological Sciences, Chiba, Japan). Exp. Cell Res.; 58: No. 1, 182-5(Nov 1969).

The cyclic variations of cellular sulfhydryl content during the cell cycle of HeLa S3 cells and its correlation with the cyclic variation of x-ray sensitivity was investigated; methodology used in the study is described. The results obtained indicated that the variation of content of non-protein (acid soluble) sulfhydryls (NPSH) and directly reacting (apparent total) sulfhydryls (APSH) of HeLa S3 cells are age-dependent, being correlated with each other. Particularly, the content of NPSH was closely related to the cyclic variation of x-ray survivals during the cell cycle. Naturally occurring NPSH, although not all of it, was considered to play an important role in the variation in lethal x-ray response of HeLa S3 cells. (C.O.)

32151 EFFECT OF OXYGEN ON THE RECOVERY OF LETHAL AND NON-LETHAL RADIATION DAMAGE. Siracka, Eva; Littbrand, B.; Revesz, L. (Karolinska Institutet Medical School, Stockholm). Exp. Cell Res.; 58: No. 1, 191-4(Nov 1969).

The recovery of Chinese hamster cells from radiation damage expressed by a diminution of clone size (decrease of growth rate or lethality) was investigated by analysis of the size distribution in relation to the number of clones that developed from irradiated populations of single cells; both oxic and anoxic conditions of irradiation were investigated and the differential enhancing effect of oxygen was noted. Cells were x-irradiated 2.5 to 3 hr after plating and, when split doses were given, again 18 hr later. The dose rate was 235 R/min at the bottom of the dishes at a distance of 43 cm from the focus. The data indicated that the radiation injury that altered the growth rate of cell population was recoverable during the interval between split doses as was the injury that concerned clonogenic capacity; the recovery of population growth was an oxygen dependent process as was the recovery of clonogenic survival; the split-dose ratio for the population size was composed of the split-dose ratios for clonogenic recovery and for population recovery; the oxygen enhancement ratio for cell population growth is larger than that for clonogenic survival. (C.O.)

32152 METHODS IN CANCER RESEARCH. VOLUME IV. Busch, Harris (ed.). New York; Academic Press Inc. (1968). 687p. $34.00.

Separate abstracts were written for three of the chapters. Other chapters present the following material: selected laboratory methods in tobacco carcinogenesis; invasive growth and metastasis in tissue culture systems; induction and transplantation of rat hepatomas with different growth rate (including minimal-deviation hepatomas); histological study of some primary and transplantable hepatic tumors in rats; isolation of nuclei and nucleoli of Morris hepatoma cells; preclinical methodology for the selection of anticancer agents; methods in cancer chemotherapy research in man; host defense mechanisms and their modification by cancer chemotherapy; preparation and characterization of infective ribonucleic acid from animal viruses; and lactate dehydrogenase in the normal and malignant state in mice and the influence of a benign enzyme-elevating virus. An author index and a subject index are provided. (C.O.)

For abstracts of individual chapters see: 32080, 32153, and 32212.

32153 METHODS FOR THE STUDY OF RADIATION EFFECTS ON CANCER CELLS. Kallman, Robert F. (Stanford Univ., Palo Alto, Calif.). pp 309-54 of Methods in Cancer Research. Vol. IV. /Busch, Harris (ed.). New York; Academic Press Inc. (1968).

Types of tumors and their relevance to the study of radiation effects on cancer cells are reviewed. Methods and problems in the measurement of radiation effect (functional criteria; morphological/biochemical criteria; growth rate effects; local tumor control; and tumor cell viability as determined by end point dilution assay) and in techniques of tumor irradiation (whole-body; localized; and dose distribution) are emphasized. It is concluded that it is necessary to evaluate radiation effects by one or more of the major functional criteria. (C.O.)

32154 PROLIFERATION OF MAMMALIAN CELLS IN VITRO AND THEIR REACTION TO X RADIATION. II. PHENOMENONS CHARACTERISTIC OF NON-LETHAL INJURIES. Miltenburger, Herbert Georg (Technische Hochschule, Darmstadt, Ger.). Strahlentherapie; 138: 595-601(Nov 1969). (In German).

The in vitro proliferation of Chinese hamster cells (B14F28) was studied after x irradiation of 100 or 300 R. The increase of microcolonies after 300 R results from an increase in dying-off cells and from a prolonged generation time between the 2nd and 4th generation. After 100 R the observed phenomena could not be distinguished from normal proliferation variations. After 300 R a cyclic variation of the non-lethal damage was observed with its maximum between the 2nd and 4th generation. This phenomenon is discussed. Any relation of the radiation damage to comparable cells (sister- or cousin-cells) was not observed after 300 R. (auth)

32155 CHANGES OF FINE STRUCTURE OF THE EPIDERMIS FOLLOWING ULTRAVIOLET IRRADIATION. Nagy, Georg; Wiskemann, Arthur; Schneider, Gert (Univ., Hamburg). Strahlentherapie; 138: 627-39(Nov 1969). (In German).

Human and, to a lesser extent, guinea pig epidermis was studied with electron microscopy at 3, 5, 8, 12, 24, and 72 hours after ultraviolet irradiation. The doses administered were 4, 8, 12, 16, and 24 times the erythema dose. In the first phase mainly exudative phenomena were observed, as intra- and intercellular edema, vacuolization of the cytoplasm, cytolysis, and swelling of the nucleus. In the second phase, however, degenerative processes were noted as condensation of the cytoplasm and pycnosis of the nucleus. The irregular dense bodies described by other authors are not a mandatory sign of the epidermal light reaction. (auth)

32156 RELATIVE RADIOSENSITIVITY OF THE NUCLEUS AND CYTOPLASM OF CHINESE HAMSTER FIBROBLASTS. Munro, T. R. (Strangeways Research Lab., Cambridge, Eng.). Radiat. Res.; 42: 451-70(Jun 1970).

Selected parts of individual Chinese hamster cells were irradiated with alpha particles from a polonium-tipped microneedle; the cells were observed for up to 14 days, and the results compared with those of 200-kV x-radiation. Large doses of alpha-radiation (>25,000 rads) delivered to the cytoplasm had no effect on proliferation; nuclear alpha-irradiation killed cells via giant or multinucleate formation. Hence the targets for cell killing by alpha-radiation are either nuclear or in the immediately perinu-

clear cytoplasm; most of the cytoplasm is insensitive. Reasons are given for believing that this result can be extended to x-rays. Small doses of alpha-radiation produced a delayed decrease in growth rate in surviving cells. The effects from x-radiation were similar qualitatively to those in conventional Puck cloning experiments; after 270 R, killed cells, small colonies, and survivors were seen, and after 1000 R most cells divided at least once but later degenerated. (auth)

32157 RADIOSENSITIVITY OF MAMMALIAN CELLS. III. EFFECT OF SUBOPTIMAL GROWTH TEMPERATURES ON RECOVERY FROM RADIATION-INDUCED DIVISION DELAY. Walters, R. A.; Burchill, B. R.; Petersen, D. F. (Los Alamos Scientific Lab., N. Mex.). Biophys. J.; 9: 1323-8(Nov 1969).

Differences between the radiation-induced damage leading to division delay in mammalian cells and damage leading to the death of the cell were studied on the basis of the effect of temperature on recovery of the ability of irradiated Chinese hamster cells to divide. To establish that all cells survived for a minimum of one postirradiation division, synchronized cultures were used for the initial studies of temperature effects on recovery of the ability to divide after x irradiation. Synchronized cells were exposed to 200 Rad while in G_2 and cooled to 4°C at various times after irradiation. The cells were incubated at 4°C for 2.5 hr, a time just in excess of the induced delay time, then warmed to 37°C. Cells that were not cooled continued dividing for 0.9 hr after irradiation. After a delay period of 2.2 hr, division resumed at the control rate; and, when compared with the control, all irradiated cells completed the first postirradiation division. In unirradiated cultures incubated for 2.5 hr at 4°C, division ceased immediately upon cooling, resumed promptly upon returning the culture to 37°C, and gave a quantitative yield. In other experiments, no recovery occurred during the time that either log-phase or synchronized populations were incubated at 4°C, and injury sustained at low dose rates of ^{60}Co γ radiation was cumulative over a period of 6.2 hr at low temperature. Postirradiation conditions influencing recovery from the induced division delay period are different from those affecting survival, suggesting that biochemical damage leading to division delay may be different from that leading to cell death. (BBB)

32158 ULTRAVIOLET FLUORESCENCE OF LYMPH NODE LYMPHOCYTES IN NORM AND IN EARLY PERIODS FOLLOWING X-RAY IRRADIATION OF RATS. Manteifel, V. M.; Meisel, M. N.; Golenko, O. D. (Inst. of Molecular Biology, Moscow). Izv. Akad. Nauk SSSR, Ser. Biol.; No. 3, 339-43(May-Jun 1969). (In Russian).

The uv fluorescence of lymph node lymphocytes in normal white rats following x irradiation with a dose of 500 Rads was studied. The fluorescence was excited by uv rays (250 to 280 nm), fluorescence intensity was recorded in a range of 320 to 380 nm. Experiments have shown that the intensity of the uv fluorescence of the lymphoid cells diminishes as they mature. The intensity of uv fluorescence was measured on the large and middle lymphocytes with approximately equal level of intensity. Five min after irradiation with a dose of 500 Rads the fluorescence intensity did not change. In 1 hour some increase of the fluorescence intensity was observed. Three hours after irradiation the intensity greatly increased. The analysis of cell distribution according to the the fluorescence intensity showed that lymphocytes of lymph nodes had different radiosensitivity. It was assumed that the uv fluorescence intensity increased in the prepycnotic cells. The reduction of the uv fluorescence intensity in lymphocytes by 6 hours following exposure may be explained by destruction of the cells in which fluorescence was increased after 3 hours of irradiation. The possible mechanisms of this phenomenon are discussed. (auth)

32159 EFFECTS OF FRACTIONATED WHOLE-BODY X IRRADIATION ON CELL PROLIFERATION IN THE INTESTINE OF THE GOLDFISH, CARASSIUS AURATUS. Rastogi, Rakesh K.; Hyodo-Taguchi, Yosuko (National Inst. of Radiological Sciences, Chiba, Japan). Annot. Zool. Jap.; 42: 193-202(Dec 1969).

The cell proliferative activity of the intestinal epithelial cells of the goldfish irradiated with single doses of 2 and 4 kR, and that with two fractionated doses of 2 kR at an interval of 1, 2, 3 and 5 days, respectively, was studied autoradiographically. ^{3}H-thymidine was injected immediately, 1, 3, and 5 days after the end of irradiation, respectively. Incorporation of ^{3}H-thymidine into intestinal epithelial cells was markedly inhibited by irradiation during 24 hours after the last irradiation in all groups, but after the inhibition period, DNA synthetic activity recovered. In groups of fish given a single 2 kR-dose and two fractionated doses at an interval of 3 or 5 days, the DNA synthetic activity recovered to the normal level within 5 days after the last irradiation. Mitotic activity of cells temporarily decreased after irradiation, and the decreased period was shorter in these three groups than in the others. Radiation-induced depopulation of cells was also restored to normal if the dose of 4 kR was given in two equal fractions separated by 3 or 5 days. From the present results, it is evident that single irradiation of 4 kR is more effective on the cell populations than the same dose applied in two fractionated doses at an interval of 3 or 5 days. (auth) (NSA of Japan)

32160 CELLULAR DEOXYRIBONUCLEIC ACID SYNTHESIS AND LOSS OF CONTACT INHIBITION IN IRRADIATED AND CONTACT-INHIBITED CELL CULTURES INFECTED WITH FIBROMA VIRUS. Tompkins, W. A. F.; Walker, Duard L.; Hinze, Harry C. (Univ. of Wisconsin, Madison). J. Virol.; 4: 603-9 (Nov 1969).

Cultural changes that follow infection of rabbit kidney cells with fibroma virus were studied. Irradiation was used to impose a permanent arrest on cell division while permitting infection in a favorable nutritional environment. Cultures of DRK cells were exposed to 5000 R of ^{137}Cs γ radiation. Characteristic alterations of cell morphology and development of multilayered piles and cords of cells were found to occur in infected cultures in which cell division was blocked by radiation or by cell crowding and serum deprivation, thus indicating no dependence upon cell division. Fibroma virus infection did not remove blocks to cell division, but it did exert distinct effects upon nuclear DNA synthesis in cells blocked by irradiation or cell crowding. Use of tritium-labeled thymidine and autoradiography demonstrated that after infection initial inhibition of nuclear incorporation was followed by sharply increased nuclear labeling at a time that coincided with beginning alterations of cell morphology and development of cell piling. (BBB)

Invertebrates

Refer also to abstracts 31870, 31871, 31911, 31924, 31925, 31941, 31942, 31953, 32281, 32286–32288, 32294–32297, 32301, 32304, 32318, 32322–32326, and 32328–32332.

32161 EFFECTS OF GAMMA IRRADIATION ON LONGEVITY AND OVIPOSITION OF THE CODLING MOTH. White, L. D.; Hutt, R. B. (Agricultural Research Service, Yakima, Wash.). J. Econ. Entomol.; 63: 866-9(Jun 1970).

The average longevity of adult Laspeyresia pomonella (L.) was extended 2.1–7.3 days when mature pupae of either sex were treated with 25, 30, 35, 40, or 45 krad of gamma radiation. The longevity of males treated as adults was unaffected by 25, 35, or 45 krad but was increased 0.8–2.0 days by 30 or 40 krad. The longevity of females treated as adults was unaffected at 25 or 45 krad, but was increased 2.2–6.2 days by a treatment of 30, 35, or 40 krad. The number of eggs deposited by females from treated pupae was not determined, but among females irradiated as adults and allowed to mate with normal males, the number of eggs deposited was significantly reduced. Reductions in numbers of eggs deposited by treated females ranged 2- to 18-fold below that of untreated females mated with untreated males. Among normal adult females allowed to mate with treated males, the effect of treatment on oviposition was not significant. (auth)

32162 PROTEIN SYNTHESIS AND RECOVERY FROM γ-RAY-INDUCED MITOTIC DELAY IN FERTILIZED SEA URCHIN EGGS. Failla, P. M.; Rustad, R. C. (Argonne National Lab., Ill.). Int. J. Radiat. Biol.; 17: 385-8(1970).

The effects of puromycin and/or N_3 in sea-urchin eggs fertilized with γ-irradiated sperm (15 or 20 kR of 663 keV γ-radiation from a ^{137}Cs source) were studied. The division delays of eggs inseminated with normal or γ-irradiated sperm are presented, after the eggs had been incubated in normal sea water or exposed to N_3 and/or 1.5×10^{-4} M puromycin for 30 min. In the absence of irradiation, N_3 and puromycin (alone or in combination) caused a mitotic delay of the order of 30 min. The delay produced by the combination of the two was usually slightly larger than that produced by either agent alone, but less than that expected on the basis of addition. The radiation induced delay was reduced when N_3 treatment alone was given, but when puromycin was given alone the radiation effect was enhanced. (UK)

32163 EFFECTS OF IRRADIATION ON INSECT HOST–PARASITE RELATIONS. Rahalkar, G. W.; Ramakrishnan, V. (Bhabha Atomic Research Centre, Trombay, India). pp 69-74 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Effects of host irradiation on the development of its parasite were investigated. Females of Bracon brevicornis readily accepted irradiated larvae of the wax moth (Galleria mellonella) and rice moth (Corcyra cephalonica) for oviposition. However,

irradiated wax moth larvae adversely influenced the viability of eggs laid on them and also the survival of the parasite grubs feeding on their bodies. The female grubs were affected more than the males. Rice moth larvae, on the other hand, exerted no significant influence on the viability of parasite eggs, but adversely affected the survival of the grubs. The progeny of parents that had been reared on irradiated larvae also exhibited some developmental changes although grown on non-irradiated host larvae, and these changes were more pronounced when G mellonella was used as the host insect. (auth)

32164 CORRELATIONS, INTERACTIONS, AND DIFFERENCES BETWEEN RADIATION EFFECTS ON LONGEVITY AND NATURAL AGING. Noethel, H. (Freie Univ., Berlin). pp 87-102 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

The non-genetic overall radiation response of insects is expressed by the fitness components "developmental rate" and "adult lifespan," and is hence related to natural aging. Based on Drosophila, with additional remarks on other insects, the paper demonstrates that, in the developmental stages, ionizing radiation affects the differentiation processes. Distinct sensitive phases are apparent for the induction of different injuries, as are effective phases during which the damage exhibits its lethal action. With increasing differentiation, the radiation sensitivity decreases. The primary biological damage is, at least in part, some kind of somatic mutation. A review of adult irradiation response is also based on Drosophila. At least two different types of induced mortality are evident. Type 1 occurs early after irradiation with high doses. It is probably due to central nervous injury and is a common effect in insects, as is indicated by a comparison of various species. Type 2 is a more delayed death at median and low doses. It is of different appearance in various insects, and this heterogeneity is even seen within one species. Thus, sterilizing Drosophila females may result in a considerable prolongation or in a drastic reduction of lifespan. Experimental evidence is found in Drosophila against the "induced aging" hypothesis of radiation death. Type 1 mortality increases with increasing age at exposure. The amount of the increase in sensitivity depends indirectly on biological age. Both of these parameters are fixed by genotype, as is the mode of interaction between them. Type 2 mortality follows an initial latent period within an "induced mortality" period. The latter lasts always the same time, independently of age at irradiation. The latent period, however, is shortened in general with increasing age at exposure. This effect seems to depend on metabolic properties rather than on aging itself, as is indicated especially by a prolongation in early adult life. (auth)

32165 DESTRUCTION OF THE POLAR CELLS OF COLORADO BEETLE EGGS BY IRRADIATION. Bluzat, R. (Faculte des Sciences, Orsay, France). pp 103-8 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In French).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

The rear pole of the blastoderm of Leptinotarsa decemlineata Say (Chrysomelidae) is subjected to local irradiation with low-energy x rays without disruption of embryonic development. Histological study of the gonads of growing larvae shows total absence of gonia after a sufficiently high dose (10,000 R) to cause certain destruction of the rear polar cells. The existence of agamic gonads differing in appearance from those in the control cells indicates that development of the mesodermic part of the gonad is independent of the presence of initial germinal cells. Two hypotheses are put forward to explain the fact that agamic larvae are almost always non-viable. It would appear that in cases where the number of gonia is less than in the control cells (e.g., eggs irradiated at 3000 R), a regulation phenomenon has come into play in the course of gonial development in the larva or pupa. (auth)

32166 SOME EFFECTS OF GAMMA IRRADIATION ON SPODOPTERA (LAPHYGMA) EXIGUA HB. (LEPIDOPTERA: NOCTUIDAE). Anwar, M. (Centre de Recherches Agronomiques du Sud-Est, Montfavet, France). pp 109-21 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In French).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

A study was made of the effect of gamma rays from a cobalt-60 source on the eggs, larvae, pupae and adults of Spodoptera exigua Hb., a lepidopteron which is harmful to crops in many climates. The insect was reared on an artificial diet based on powdered cabbage and wheat-germ. The irradiation of one- and four-day-old eggs with 3, 6 and 9 krad showed that none of the one-day-old eggs hatched, while the four-day-old ones gave 52, 18 and 0% of adults respectively. The larvae hatched from irradiated eggs showed retarded development, and the butterflies which developed were listless and of low fertility. Mature larvae irradiated at 3 and 5 krad give 100 and 22.5% of adults respectively; irradiation at 7 krad or more completely stops the production of adults. Irradiation of young pupae either kills them or leads to the hatching of malformed adults. Irradiation at 50 krad of pupae at the end of their development has no effect on hatching. The adults from nymphs irradiated at 50 krad show a fertility reduced to 0.5%, while the adults which have just hatched show total sterility after irradiation at the same dose. Higher doses reduce the frequency of mating, while females irradiated at 30 krad and mated with normal males lay infertile eggs. (auth)

32167 RADIOSENSITIVITY OF SITOPHILUS ZEAMAIS MOTS (S. ORYZAE L.) AT VARIOUS STAGES OF DEVELOPMENT: A STUDY OF THE LARVAL STAGES BY MEANS OF RADIOGRAPHY AND "ACTOGRAPHIC" RECORDING. Pesson, P.; Girish, G. K. (Institut National Agronomique, Paris). pp 123-37 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In French).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

An original method of study, based on the employment of an "actograph" which records the vitality of the larval stages and makes it possible to study the larva population inside grains (actograph for electro-acoustic detection developed by the INRA Acoustic Physiology Laboratory, Jouy-en-Josas) is described. The contamination rate and the death rate of the larvae are observed by radiography. The effects of irradiation at doses of 2000, 4000, 8000 and 16000 rad are studied in the egg stage, on larvae aged 5-7 days, 13-15 days and 19-21 days and on adults, whose fertility is measured 0-5 days, 5-10 days and 10-15 days after irradiation. The effects of irradiation on the second generation bred from the various stages irradiated are noted. (auth)

32168 INFLUENCE OF DIAPAUSE ON THE RADIOSENSITIVITY OF KHAPRA BEETLE LARVAE. Rahalkar, G. W.; Nair, K. K. (Bhabha Atomic Centre, Trombay, India). pp 149-54 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Studies to determine the effects of varying periods of diapause on the radiosensitivity of the larvae of Trogoderma granarium showed practically no mortality in the irradiated larvae during diapause, but only after the diapause was broken at 38°C. As the calculated LD_{50}s for 10, 20 and 30 days of post-irradiation diapause were not significantly different, it was also evident that increases in the length of diapause time had no significant effect on post-diapause survival time. On the other hand, pupation seemed to be influenced by the duration of diapause in the irradiated larvae. This effect was best discernible at low doses. The significance of these findings is discussed. (auth)

32169 THE EFFECT OF GAMMA RADIATION ON THE FERTILITY AND LONGEVITY OF DOLICHODERUS QUADRIPUNCTATUS (HYMENOPTERA: FORMICOIDEA DOLICHODERIDAE). Torossian, C. (Faculte des Sciences, Toulouse); Causse, R. pp 155-64 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In French).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

A batch of 27 colonies of the ant Dolichoderus quadripunctatus was studied with regard to the effect on longevity and fertility of gamma irradiation at doses between 12,500 and 150,000 rad. The results are presented in the paper. For colonies consisting solely of workers, the mortality curve is linear with doses between 150,000 and 50,000 rad. The LD_{50} is reached in 4 days for the 150,000-rad dose and 16 days for the 50,000-rad dose. The lowest dose used in the experiments (12,500 rad) produced an LD_{50} after 18 days. For the control colonies, the LD_{50} occurred within experiments (12,500 rad) produced an LD_{50} after 18 days. Fertility, colonies, the LD_{50} occurred within about thirty days. Fertility, which is normally regular and constant in colonies of workers of Dolichoderus quadripunctatus is expressed by the R.F. ratio [R.F. = reproduction factor = (number of eggs)/(number of workers at the beginning of the experiment)]. The R.F. of the control (unirradiated) colonies was about 1.60, while that of the irradiated colonies ranged from 0 to 0.06. These extremely low values showed that to all intents and purposes the treated colonies were made sterile. This sterility was final, no laying being observed in the irradiated colonies, by the time they died out. In colonies

with a queen, only the queens were irradiated, with gamma doses of 50,000, 100,000 and 150,000 rad. The results obtained for longevity showed in every case a considerably higher resistance of the females than the workers under the same conditions. Where fertility is concerned, the irradiated females showed a considerable and almost immediate reduction in egg laying. This was followed in the colonies by a resumption of laying by the workers, since the queen could no longer inhibit this. The fertility of the irradiated females subsequently diminished, and became nil from the eighteenth day. The queens did not thereafter resume laying. (auth)

32170 CHEMOSTERILANTS IN ENTOMOLOGY AND THE STERILE-MALE TECHNIQUE. Borkovec, A. B. (Dept. of Agriculture, Beltsville, Md.). pp 201-8 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Chemosterilants have been often referred to as agents producing dominant lethal mutations in the germ cells of treated organisms. Recent studies of the mode of action of various chemosterilants in insects indicate that there are many other pathways by which chemical compounds can induce sterility in insects. Although the genetic mechanism still appears to be the most plausible explanation of the mode of action of many chemosterilants in male insects, other alternatives must be considered for explaining the chemical sterilization of female insects. The elucidation of the biochemical processes leading to sterility is important not only because chemical mutagenesis was first discovered in an insect (Drosophila melanogaster); chemicals offer a flexible, and sometimes the only available, method of inducing sterility in economically important insects which can be utilized in the sterile-male technique of insect control. As distinct from radiation, chemosterilants can be utilized for sterilization of the naturally occurring pest populations. In sterile-insect release programmes, chemosterilants become of importance whenever secondary radiation effects interfere with longevity and sexual competitiveness of radiation-sterilized insects. The understanding of the mechanism and mode of action of chemosterilants will aid in the search for new types of effective compounds and in designing new materials specific to insects or even to individual insect species. The sterility principle in pest control has thus far been successfully applied only to insects, but vertebrate pests will certainly be considered in the future. Chemosterilants may be the most effective tool for sterilization of vertebrate organisms. (auth)

32171 ACTION OF TEPA ON THE PUPAL DEVELOPMENT OF DACUS OLEAE GMEL. (DIPTERA: TEPHRITIDAE). Fytizas, E.; Bacoyannis, A. (Institut Phytopathologique Benaki, Kifissia, Greece). pp 209-15 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In French).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Third-stage (fully grown) larvae obtained from an artificial culture of Dacus oleae were dipped, a few hours prior to pupation, into aqueous solutions of Tepa for 30 minutes. The following results were observed by the authors: even at the highest concentration tried (2%), Tepa had no effect on the mechanism of pupation, perhaps because of the late treatment; pupal development was inhibited after the larvae had been dipped in solutions of above 0.125%, and death occurred at different stages of pupal life, the time of occurrence depending on the concentration of Tepa in the dipping solution; there was practically no difference between the minimum lethal dose and the maximum sterilizing dose, the safety factor being almost equal to 1. The authors discuss these results in comparison with those of a previous experiment during which Tepa was applied to adults shortly after they had emerged. The safety factor was then of the order of 50. In addition, the results of the two experiments mentioned above are compared with those of other experiments by different authors on the same insect subjected to gamma radiation. This comparison shows that, irrespective of the means of treatment (gamma rays or Tepa), the safety factor is large when the insects, at the time of treatment, are past the stage of histolysis-histogenesis. (auth)

32172 IRRADIATION EFFECTS ON RESPIRATION AND BLOOD DIGESTION IN THE TICK ORNITHODOROS THOLOZANI AND THEIR IMPORTANCE FOR THE STERILE-MALE TECHNIQUE. Galun, Rachel; Warburg, M. (Israel Inst. for Biological Research, Ness-Ziona). pp 249-58 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Soft ticks feed exclusively on blood at very long intervals. The ingestion of blood is accompanied by a manifold increase in oxygen consumption. This increase in metabolic rate is not affected by irradiation up to 16,000 R. Irradiation doses much lower than that required to produce 99% dominant lethals in males reduce the rate of digestion of blood taken by the tick. Thus at 4000 R the rate of digestion in males is slowed down, while 16,000 R is required to produce 99% dominant lethals. In females, a dose of 4000 R is necessary to prevent oögenesis, but the rate of digestion is slowed down even at 1000 R. This effect on digestion causes ticks which were fed immediately after irradiation to feed much less frequently thereafter, males and nymphs exposed to 16,000 R took a first blood meal after irradiation and did not feed again before death. Adult males are very little dependent on the blood meal for survival and successful mating, hence the irradiated males can be useful in controlling tick populations. Furthermore, since they do not take a second blood meal, they would not introduce any harmful effect into the environment. (auth)

32173 RADIATION SENSITIVITY AND REPAIR OF CHROMOSOMAL DAMAGE. Stroemnaes, Oe. (Univ. of Oslo). pp 341-54 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

If the sterile-male technique in pest control is used, it is important for irradiated sperm to have a dominant lethal effect. In Drosophila, sperm and spermatogonia are radiation resistant cells compared with spermatids and spermatocytes. After a moderate radiation dose, the male might be fertile for several days and then go through a sterile period. Fertility is regained when cells that were spermatogonia during the time of irradiation are available for fertilization. It is therefore important for the irradiation dose to be lethal to all spermatogonia so that no repopulation of spermatogonial cells can occur. It should be possible to find a radiation dose which renders insects sterile without impairing their mating behavior and vitality. The radiation dose can also be adjusted by changing internal or external environments during irradiation. (auth)

32174 COMPARATIVE STUDY OF THE EFFECT OF GAMMA AND NEUTRON IRRADIATION ON THE REPRODUCTIVE ORGANS OF THE MEDITERRANEAN FRUIT FLY CERATITIS CAPITATA WIED. (DIPTERA: TRYPETIDAE). Causse, R. (Institut National de la Recherche Agronomique, Vaucluse, France); Feron, M.; Pereau-Leroy, P. pp 355-64 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In French).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Plant radiobiology studies have demonstrated that plants grown from grains exposed to neutron irradiation show, for a given survival rate, greater sterility than those grown from grains exposed to gamma rays. It therefore seemed of interest to determine whether the same phenomenon occurs with insects, with a view to making use of it for pest control. Treatment with gamma rays at sterilization doses (more than 3 krad) inhibits ovogenesis; at substerilization doses a variable number of ovarioles may show normal development. In the male, at higher doses (8-10 krad), the spermatozoids formed remain normal and the testes retain their usual appearance, but spermatogenesis is greatly reduced. Irradiation with neutrons by exposing pupae in a reactor core causes quite different effects. Relatively high doses of the order of 1000 rad inhibit the development of the gonads and leave the male with a residual fertility which is very weak or nonexistent, the testes being atrophied by progressive reduction of the region containing spermatocytes and spermatogonia. In the females, the ovary appears as an undifferentiated mass. At lower doses, the females show a typical development of certain ovarioles, resulting in the formation of morphologically abnormal eggs; histological studies show an aberrant disposition of the vitelline cells, and various abnormalities. (auth)

32175 REPRODUCTIVE PERFORMANCE OF FEMALE BRACONIDS COMPARED AFTER (A) BRIEF AND (B) PROTRACTED EXPOSURES TO IONIZING RADIATIONS. Grosch, D. S. (North Carolina State Univ., Raleigh). pp 377-89 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

^{85}Sr sources are installed in the initial US biosatellites to provide calculable dose levels during three-day orbital space flights. Such protracted exposures are longer than those used customarily in insect radiobiology and shorter than those of ecological studies. This paper concerns results from the ground controls of ill-fated

US Biosatellite A and compares them with results from other dose rates and types of radiation. Males are packaged separately and used for mutational studies to be reported elsewhere. To compare the vulnerability of cell types in the ovariole sequence, nearly 1000 virgin females from a vigorous out-cross are used, half for ground controls and half for the satellite launched. Samples of 20–25 wasps are packed in each of two screw-capped capsules inserted into housings in plastic modules which also incorporate thermisters and radiodosimeters. These packages are fixed in shielded positions as well as in places which receive one of four levels of gamma rays from the ^{85}Sr source. Each treatment thus consists of 45–50 virgins; a similar number receives a sensitizing preflight exposure to 2000 R of x-rays. After the flight period daily egg production is scored to detect resorption following gross chromosomal damage, embryonic deaths to reveal more subtle damage, and maternal life span as a measure of somatic fitness. In most insects bundles of numerous ovarioles confound interpretation relating cell status during exposure to eggs deposited subsequently. Habrobracon's four synchronized ovarioles provide a uniquely suitable system for studying radiosensitivity of a sequency complete from specialized oöcytes through oöcyte-trophocyte units to primitive interphase cells. Following a series of doses, the family of oviposition curves reflects the vulnerability of differentiating units in a valley which deepens and broadens with increased dose. At high dose rates, lowest egg production occurs on day 7. The pattern, well established for x-rays and ^{32}P β-rays, has now been demonstrated for γ-rays from the Raleigh ^{60}Co Gammacell and the Woods Hole ^{137}Cs source, although 1.4 times the x-ray dose is required to produce the same amount of damage. When the gamma exposure was spread over three days the valley did not appear until the eighth day. Females tested simultaneously and treated identically except that their x-ray exposure was brief provided the usual 7th-day low. Previously valley deferment was observed only when studying ingested radioisotopes where a necessary prestarvation obscured the significance. Another unpredicted response to the protracted gamma dose was a control level productivity of eggs derived from exposed oögonia. Recovery mechanisms were evidently able to keep pace with radiation damage. On the other hand, embryonic lethality was related to dose during all periods studied and dose rate was not important except for the most mature oöcytes. As scored by von Borstel categories, stage I deaths decreased and stage III types increased with age of the mothers until the latter predominated. This change is age-related and not dose-dependent. Biochemically, predominance of stage III death can be induced, even in eggs from young mothers, by feeding either RNA or protein inhibitors, but not by interfering with DNA synthesis. We postulate physiological involvement of nurse cells and fat body or their interrelations. Mean life span ranged from 19.52 ± 1.34 days after 4320 R to 22.35 ± 0.91 for controls. Biosatellite B, the second effort, was recovered successfully. After two days in orbit the reproductive performance of females differed strikingly from that repeated in ground controls. Most significant was egg deposit in a nearly contourless pattern reminiscent of a compensatory response to mitotic inhibition. (auth)

32176 EFFECTS OF THE LENGTH OF STORAGE UPON THE INVASIVENESS OF X-IRRADIATED DICTYOCAULUS VIVIPARUS LARVAE. Tomanek, Josef; Prochazka, Zdenek (Veterinary Research Inst., Brno). Doc. Vet.; 7: 261-5(1968).

Dictyocaulus viviparus larvae irradiated with 40 kR were stored for 5 weeks at +4°C and checked for viability and invasiveness for guinea-pigs during storage. The viability and invasiveness for guinea-pigs of the irradiated larvae did not differ substantially from those shown, by unirradiated larvae of the same age. A decrease in invasiveness was observed only shortly after irradiation (1.5 hours after irradiation) as shown by a significant decrease in larval counts recovered from the guinea-pig lung 3 days after infection. At 24 hours after irradiation the invasiveness of the larvae reached the mean values obtained for infection with unirradiated larvae. No explanation can be offered for the transient decrease in invasiveness of Dictyocaulus viviparus larvae shortly after irradiation. (auth)

32177 EGG PRODUCTION AND EMBRYO LETHALITY FOR HABROBRACON FROM BIOSATELLITE II AND ASSOCIATED POSTFLIGHT VIBRATION EXPERIMENTS. Grosch, D. S. (North Carolina State Univ., Raleigh). Mutat. Res.; 9: 91-108 (Jan 1970).

In the reproductive performance of female Habrobracon, striking contrasts were revealed between results from the actual biosatellite flight and those from experiments with the recovered vehicle subjected to forces of simulated launching and recovery. The conditions of the 2 types of experiments differ mainly in influences of orbital flight, of which weightlessness seems most notable. To summarize for the 3 criteria of damage studied: Orbital flight effectively cancelled the characteristic radiation-induced decrease in egg production. On the other hand, the forces of vibration and acceleration improved oviposition only slightly during the more radiosensitive period of the developmental sequence. Excepting metaphase-I results, the only evidence of low hatchability was obtained for an ordinarily invulnerable cell type giving rise to eggs deposited on the 3rd day after biosatellite recovery. Subsequently the hatchability of the haploid eggs was excellent even during the period ordinarily most radiosensitive. In contrast, hatchability data from the simulated flight showed the usual pattern of response except for a moderate alleviation of the senile decline after the 15th day. Death occurred in a variety of stages in eggs from wasps of the simulated flight, but no stage-I (i.e., cleavage failure) deaths were obtained during the periods of excellent hatchability of biosatellite wasp eggs. The survival and life span of adult females was excellent and attests to the somatic fitness of experimental wasps. An interpretation of the braconid response to space flight in the presence of chronic γ-ray exposures must explain the unimpaired survival of cell types providing a surprisingly high fecundity, plus the adequacy of these eggs in supporting embryonic development. Possibly under packaged inactivity and weightlessness a stasis of cytological structure provides an opportunity for biochemical mechanisms to repair presumptive radiation lesions. The same stasis may be deleterious to the oocyte-nurse cell complex engaged in vitellogenesis of units destined to be deposited as 3rd day eggs. (auth)

Vertebrates

Refer also to abstracts 31839, 31841, 31842, 31845–31850, 31852, 31853, 31855, 31863–31865, 31868, 31869, 31872–31874, 31877, 31947, 31948, 31950, 31952, 32004, 32036, 32038, 32040–32046, 32049, and 32136.

32178 (BNL-tr-302) EFFECT OF REMOVAL OF A LARGE QUANTITY OF BONE MARROW ON THE BLOOD SYSTEM AND SURVIVAL RATE OF IRRADIATED RATS. Rudakov, I. A.; Zyablitskii, V. M.; Zhukova, N. A.; Rudakova, S. F. Translated by Stephen J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Byull. Eksp. Biol. Med.; 1: 40-2(1968). 6p. Dep. CFSTI.

The effects of a massive loss of bone marrow on hemopoiesis in healthy rats and irradiated rats were investigated. The effect of the stimulation of the washing out of the hemopoietic cells into the vascular canal on the survival rate of irradiated rats was also studied. During the entire observation period following massive loss of bone marrow, an increase in erythropoiesis was observed. In the irradiated rats, clinical manifestations of radiation sickness and hematological disturbances were more pronounced in rats that were not subjected to massive losses of bone marrow (control group). The clinical manifestations of radiation sickness were also more acute in control rats than those subjected to washing out of the hemopoietic cells into the vascular canal. Data are presented in tabular form and results are discussed in relation to other research. (C.O.)

32179 (COO-1156-32) RADIATION $LD_{50/30}$ OF PIKAS (OCHOTONA PRINCEPS) IN THE NATURAL ENVIRONMENT AND IN CAPTIVITY. Markham, O. D.; Whicker, F. W. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). [1968]. Contract AT(11-1)-1156. 17p. Dep. CFSTI.

Estimates of the $LD_{50/30}$ from ^{60}Co γ radiation were made for a group of pikas (Ochotona princeps) held in captivity and for another group observed in the natural environment near the summit of Mount Evans, Colorado. The $LD_{50/30}$ estimate was 560 R (438 to 717 R; 95% confidence limits) for captive animals and 380 R (250 to 578 R) for pikas at Mount Evans. Mean survival time for irradiated pikas was 9 to 13 days in captivity and 5 to 7 days in the natural environment. Results are discussed in relation to artificial stresses resulting from captivity and natural stresses such as intraspecific competition and predation. (auth)

32180 (COO-1156-33) RADIATION $LD_{50/30}$ OF RICHARDSON GROUND SQUIRRELS. Markham, O. D.; Whicker, F. W.; Hansen, R. M. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). [1969]. 5p. Dep. CFSTI.

Fifty-five Richardson ground squirrels (Citellus richardsoni) were captured near Estes Park, Colorado, providing an opportunity for study of the radiation $LD_{50/30}$. Animals were whole-body irradiated with ^{60}Co at 50 R/min. The dose necessary to produce 50% mortality within 30 days was 1260 R (1145 to 1386 R-95% confidence limits). Among the Sciuridae, the Richardson ground squirrel appears to be relatively radioresistant. It is concluded that more information on the $LD_{50/30}$ of different groups of animals is needed before a relation between the response of animals to lethal doses of radiation and their phylogenetic groupings can be determined. The desirability of the Richardson ground squirrel

for studies of comparative response of animals in captivity and in the natural environment is suggested. (C.O.)

32181 (NYO-3970-33) CELL POPULATION KINETICS IN THYMUS LYMPHOCYTES UNDER CONTINUOUS IRRADIATION. Fabrikant, Jacob I. (Johns Hopkins Univ., Baltimore, Md. Dept. of Radiological Sciences). [1969]. Contract AT(30-1)-3970. 14p. (CONF-691041-1). Dep. CFSTI.

From International Symposium on Biological Aspects of Radiation Protection, Kyoto, Japan.

Mice were given whole body γ radiation continuously at 45 rad/day. Tritium-labeled thymidine was injected intraperitoneally for pulse-labeling and percentage labeled mitoses experiments. Histologic sections of the thymus were prepared for autoradiography and the reticular cells, large, medium, and small lymphocytes were classified according to cell size and morphological characteristics. Percentage labeling indices were determined in each lymphoid cell population and plotted against the overall labeling period. Under continuous irradiation, the thymus could maintain a steady level of cell population for two weeks or more. There was a progressive shift in the cell size distribution to a greater proportion of the more primitive forms, increased labeling in all lymphoid cell compartments, but particularly in reticular cells and medium lymphocytes, and an increased rate of accumulation of labeled small lymphocytes. These changes were associated with the narrowing of the distribution of lymphoid cell cycle times, but with little change in the duration of the DNA synthesis period or the overall mean generation time. (H.L.W.)

32182 (ORNL-tr-2315) INVESTIGATIONS CONCERNING THE PART PLAYED BY IONIZING RADIATION IN EXPERIMENTAL INFECTION WITH PATHOGENIC STAPHYLOCOCCI. Nestoresco, N.; Benes, S.; Strimbeanu, I. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Arch. Roum. Pathol. Exp. Microbiol.; 20: 599-616(1961). 20p. Dep. CFSTI.

Some aspects of the part played by ionizing radiation in the experimental infection of rabbits with pathogenic staphylococci have been investigated. Irradiation was performed by administering a total dose of 650 R in fractions of 50 R each. The death rate of irradiated and infected animals was higher than in the controls. A decrease of leukocytes was recorded in the irradiated animals. However, the leukocytic reaction to infection was present both in non-irradiated and in irradiated animals. The infected animals (irradiated or not) moreover displayed a monocytic reaction. Comparatively small differences of humoral immunological responsiveness were found to exist between irradiated and infected animals and infected non-irradiated controls. The histopathological lesions were more severe in the irradiated and infected group than in the controls. The animals displayed a wide range of variation in individual responsiveness as regards all the aspects investigated. The correlation between the findings of the authors and the percentage rate and succession of fatality must hence be considered as an open problem. (auth)

32183 (UR-49-1289) EFFECTS OF UNILATERAL AND BILATERAL RENAL IRRADIATION ON PARAMETERS RELATED TO RENAL HYPERTENSION. Courtade, Elpiniki Tsinga (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1970. 200p. Dep. CFSTI.

Thesis.

In order to determine pathophysiologic mechanisms by which renal irradiation induces hypertension, male rats were studied at periodic scheduled sacrifice times after single x ray exposure of 2000 R to one or both temporarily exteriorized kidneys. These studies included blood pressure measurements, renal histopathology, and determination of the granularity of the juxtaglomerular apparatus, urine output and water intake, sodium and potassium content in blood and urine, adrenal cortical fat and width of zona glomerulosa, body and organ weights (kidneys, adrenals, whole heart, and heart ventricles). Increased systolic blood pressure was noted after irradiation and was of greater severity in the bilaterally irradiated animals. In general, arteriolonephrosclerotic changes developed at a similar rate in the irradiated kidneys of the unilaterally and bilaterally irradiated animals until the final time interval when there was a greater degree of arteriolonephrosclerosis in the bilaterally irradiated animals. There was a reduction of the total renal mass in the irradiated kidneys, the degree of which depended on the amount of renal tissue exposed. The juxtaglomerular granulation index was decreased in the irradiated kidneys. There was a rough inverse correlation between the average JGI of both kidneys and the blood pressure. Bilateral renal irradiation produced a diuretic effect of greater severity and duration than unilateral irradiation. An increased water intake and decreased concentration of sodium and potassium was associated with the increase in urine output. No changes occurred in the total excretion of sodium and potassium and in the serum concentration of sodium and potassium. The width of the zona glomerulosa remained relatively constant. These results are discussed in terms of possible mechanisms involved in the development of radiation-induced hypertension. (auth)

32184 RADIATION DEPIGMENTATION OF MOUSE HAIR: SPLIT-DOSE EXPERIMENTS AND MELANOCYTE PRECURSORS (AMELANOTIC MELANOBLASTS) IN THE RESTING OF HAIR FOLLICLE. Potten, Christopher S. (Allegheny General Hospital, Pittsburgh); Chase, Herman B. Radiat. Res.; 42: 305-19(May 1970).

The depigmentation response of resting hair follicle melanoblasts to x-rays was studied. The survival curve for these cells extrapolated to a value of about 6 and the D_0 value is about 200 Rads. Three days after initiating hair growth the physiological state of the cells altered and the survival curve showed an increase in the D_0 and D_q. This was accompanied by a probable increase in cell number. Split-dose experiments with cells believed to be in G_0 showed a recovery factor of about 6 and a recovery curve that reached a plateau at this value after time intervals of 6 hours or more. The survival curve obtained when variable second doses were delivered eight hours after a priming dose of 500 Rads showed the same D_0 value as the single dose curve but extrapolated to about 2.7. (auth)

32185 LETHALITY OF ^{137}Cs AND ^{90}Sr ADMINISTERED IN COMBINATION TO RATS. Thomas, R. G.; Thomas, Randi L. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Contract AT(29-2)-1013. Radiat. Res.; 42: 282-91(May 1970).

Two radionuclides that localize in different body organs elicit antagonistic, synergistic, or directly additive biological effects when administered in combination. Graded doses (range, 1.4 to 5.3 mCi/kg body weight) of the bone seeker ^{90}Sr were injected intraperitoneally into rats simultaneously with graded doses (range, 3.4 to 26.8 mCi/kg) of the rather diffusely localizing radionuclide ^{137}Cs. Times to reach acute death in 50% of the animals ranged from 9 to 18 days. Radiation doses calculated for these injected mixtures ranged from 3900 to 11,000 Rad to the skeleton from ^{90}Sr and from 320 to 2200 Rad to the whole body from ^{137}Cs. There is some indication from comparing the time to acute death with the calculated radiation doses, that these radionuclides acting in combination give at least an additive effect to lethality. (auth)

32186 BLOOD CHANGES IN IRRADIATED COTTON RATS AND RICE RATS. Kitchings III, J. T.; Dunaway, P. B.; Story, J. D. (Oak Ridge National Lab., Tenn.). Radiat. Res.; 42: 331-52(May 1970).

Response of the peripheral blood after irradiation was measured in two species of wild rodents, the radiation-resistant cotton rat (Sigmodon hispidus) and the radiosensitive rice rat (Oryzomys palustris). Blood samples were taken before exposure to 200 or 600 Rads and then at periodic intervals after irradiation. Erythrocyte counts, hemoglobin concentrations, and hematocrit percentages were unchanged for the cotton rats at both dose levels and for the rice rats receiving 200 Rads. However, rice rats receiving 600 Rads developed a severe normocytic anemia by the 13th day after irradiation and died before the 15th day postirradiation. Leukopenia developed in both species and was dose-dependent within each species. Leukocyte counts in the cotton rats receiving 200 Rads were less reduced and recovered to normal levels faster than in the group exposed to 600 Rads. Similar patterns were noted for the rice rats, but recovery was slower and preirradiation levels were not reached within 30 days. Patterns of reduction and recovery for total leukocyte count were primarily a reflection of the response of the small lymphocytes. Recovery of the leukocytes in a group of cotton rats parasitized with a blood parasite of the genus Hepatozoon and receiving 600 Rads resembled the recovery pattern for nonparasitized animals receiving only 200 Rads. A significant reduction in serum albumin and a corresponding rise in the β-globulin fraction of the rice rats receiving 600 Rads were noted on the 11th day postirradiation. No significant alteration was apparent in the composition of cotton rats after both doses or rice rats receiving 200 Rads. (auth)

32187 LYMPHATIC CAPILLARIES OF THE LIVER IN EXPERIMENTAL RADIATION INJURY AND SURGICAL TRAUMA. Ogii, P. E. Klin. Khir., 3: 28-33(Mar. 1967). (In Russian).

Changes in the lymphatic capillaries of the liver as a result of x irradiation [219, 657, and 1096 (lethal dose) Rads] followed by surgery of the livers were studied in sixty-eight 2.5- to 3.0-kg rabbits by observing changes in the blood, electrocardiograms, body temperatures, and body weights. Fifteen controls were operated on but not irradiated, and no treatment was given to 3 rabbits. Leukopenia was most obvious at the radiation sickness crisis time (12 to 14 days after treatment) and in the terminal stages of those given the lethal doses. In the first two groups compensatory

changes occurred. The 219-Rad animals showed only moderate signs of acute radiation sickness, with 0.5% weight loss and 25 to 30% decrease in leukocytes in the peripheral blood. Capillaries near the wound increased 2 to 4 times in diameter and had lacunae with detached islets and walls joined with distinct cords. The 657-Rad animals showed 8 to 9% weight loss and 35 to 45% decrease in leukocytes. Capillaries were even larger than in the 219-Rad group, the walls appeared serrated and unformed, and some were ruptured. The 1096-Rad animals had temperatures of 40 to 42°C, lost 16 to 19% weight, and showed a 90% decrease in leukocytes. The walls of capillaries near the wounds were very much deformed and penetrable, and the vessels were sinus-like. (TTT)

32188 USES OF RADIOISOTOPE TECHNIQUES IN THE STUDY OF THE CHANGES OF CELL KINETICS INDUCED IN THE HEMOPOIETIC TISSUE BY PAN-IRRADIATION. Bergonzi, M.; Riccardi, A. (Univ., Milan). Minerva Fisiconucl., 11: 167-72(1967). (In Italian).

Compounds tagged with ^{32}P, ^{59}Fe, ^{51}Cr, and ^{35}S are used for the study of kinetics of life processes. Recently methionine-^{75}Se and diisopropylfluorophosphate-^{32}P ($DF^{32}P$) have found increasing application, particularly for the study of the formation and the development of blood corpuscles. The interference of radiation with hematopoietic action of bone marrow was shown by the following experiment: 10 adult male rabbits of an average weight of 3.000 kg were exposed to total-body radiation of 400 rad from a ^{60}Co source. Another group of 10 rabbits of the same type served as control. Twelve hours after irradiation all rabbits received intravenous injections consisting of 4 μg methionine-^{75}Se + 10 μg $DF^{32}P$ with a combined activity of 10 μCi. After 13, 40, 120, and 360 min and then from 1 to 24 days after injection blood samples were taken. These corpuscles were counted in a well scintillation counter for the γ-activity of ^{75}Se, and with a Geiger–Müller counter for β-activity of ^{32}P. The erthrocyte count of the irradiated animals was one-fifth that of the unirradiated controls. The leukocyte count, marked with $DF^{32}P$, showed that about 10 min after irradiation it was twice that of the controls and dropped to one-third in 3 days, while controls showed only a reduction by one-third. During the following 10 days the count in the controls remained stable, while the irradiated animals showed a plateau for only 3 days and then went down rapidly. By introduction of $DF^{32}P$ it was possible to measure the leukocyte concentration. By comparing its development with the concurring evolution of erythrocytes, a picture of the changes brought about by irradiation in the circulating blood elements and in the constituents of the medullary reserves was obtained. Using methionine-^{75}Se, the incorporation of this tagged amino-acid into the hemoglobin molecule could be recorded. From analysis of the curves obtained from the data, conclusions were drawn about the degree of damage sustained by the hematopoietic substance in total-body irradiation and the rapidity with which this damage is restored. (F.J.W.) (TSS)

32189 POTENTIALS OF THE RABBIT BRAIN DURING EXPOSURE TO ELECTROMAGNETIC FIELD. Chizhenkova, R. A. (Inst. of Higher Nervous Activity and Neurophysiology, Moscow). Fiziol. Zh. SSSR, 53: 514-19(May 1967). (In Russian).

By means of electrodes inserted into the brain, various regions of rabbit brains were subjected to the action of a constant, a high-frequency, and an ultra-high-frequency electromagnetic field. Observed changes in electrical activity, as shown in electroencephalograms, indicated that the observed electrical reaction of the brain in an electromagnetic field is the result of the summation of two effects. A local action, that results in a disruption in the structures studied, is the most obvious in the cortex of the large hemispheres and is due to a high absorption of energy in the neocortex. A secondary effect is on development of brain tissue. Observations are correlated with literature (19 references) data. (TTT)

32190 SH-GROUPS IN IRRADIATED SKIN. Csermely, E.; De Panfilis, G. Minerva Dermatol., 43: 505-6(Oct. 1968). (In Italian).

Effects of SH groups on normal human skin after irradiation with x rays were observed. Small sections of facial skin of men and women in the age range from 57 to 78 years were removed before and after irradiation with a Dermopan apparatus at doses of 100, 250, 500, and 1000 rad. Biopsies were made 12 and 24 hours, 4, 8, and 15 days after irradiation. The samples were frozen in CO_2, dissected in a cryostate and stained according to the method of Chevremont and Frederic. Thus zones containing SH groups attained a coloration from dark green to blue, depending on the SH-group concentration. The color intensity of non-irradiated skin was uniform and not much accentuated under the corneal stratum, but showed intensively colored irregular granuli in the basal stratum. The appearance of irradiated skin was not much different, notwithstanding irradiation dose and time elapse. These findings are in direct contrast to those of other authors. According to Frederic the SH-groups in skin of irradiated guinea pigs are reduced at 3000 rad, but not at doses from 1500 to 2000 rad. According to Guerrier the SH-group content of human skin decreases upon irradiation with 6000 to 7000 rad in direct relation to the received dose. The dosages reported in this paper are much lower since it is unusual to apply such high doses in dermatological practice. However, within the range of irradiation doses reported here, no reducing effect of radiation on SH-group content could be observed. (F.J.W.)

32191 PROLIFERATIVE AND PHAGOCYTIC CAPACITY OF THE RETICULOENDOTHELIAL SYSTEM OF SUBLETHALLY IRRADIATED MICE. Fred, Richard K.; Dobson, Ernest L.; Kelly, Lola S.; Shore, Moris L. (Dept. of Health, Education, and Welfare, Rockville, Md. Univ. of California, Berkeley). RES, J. Reticuloendothel. Soc.; 7: 453-70(Apr 1970).

The response of the RES to glucan treatment was studied in sublethally irradiated specific pathogen-free (SPF) mice. Glucan is believed to induce proliferation of the RES with a concomitant increase in the RE phagocytic activity. Whole-body ^{60}Co gamma irradiation initially inhibited the increase in RE phagocytic activity ordinarily produced by glucan. Almost normal response, however, was seen when the glucan was given 3 to 7 days post-irradiation. The effect of sublethal irradiation directly on RES phagocytic function was investigated. A marked spontaneous increase was observed in the RE phagocytic activity postirradiation in conventional mice. This spontaneous increase was inhibited by treatment with nonabsorbable antibiotics. Further, SPF mice did not ordinarily display as marked a spontaneous increase in RE phagocytic function postirradiation as conventional mice. (auth)

32192 X-RAY IRRADIATION AND THYMECTOMY AS THE FACTORS ENHANCING THE CHEMICAL CANCEROGENESIS IN MOUSE SKIN. Schneiberg, K.; Gorski, T. (Inst. of Oncology, Gliwice, Poland). Pol. Med. J., 8: 647-53(1969).

Translated from Nowotwory, Vol. 17, No. 4, 1968.

The results of investigations made on 102 CBA mice indicated that thymectomy followed by a whole-body irradiation with 500 R of x rays increased the incidence of skin epidermoid carcinomas after serial spraying with methylcholanthrene. Neither irradiation nor thymectomy alone enhanced chemical cancerogenesis in the examined animals. Most probably one of the important factors affecting the neoplastic process is the age of the animals subjected to thymectomy. (auth)

32193 CHEMICAL SENSES. Tucker, Don; Smith, James C. (Florida State Univ., Tallahassee). Contract AT-(40-1)-2903. Annu. Rev. Psychol., 20: 129-58(1969).

An extensive review of the anatomical and physiological aspects of the olfactory and gustatory senses of several animal species is presented. The detection of x rays by the olfactory system and x ray-conditioned taste aversions are also mentioned. (F.M.M.)

32194 SURVIVAL OF TYPE A SPERMATOGONIA FOLLOWING X-IRRADIATION. Clow, Duane J.; Gillette, Edward L. (Colorado State Univ., Fort Collins). Radiat. Res.; 42: 397-404 (May 1970).

A quantitative study of the number of type A spermatogonia surviving 4 days after a single exposure to the testes of 800 R, 1000 R, 1200 R, 1400 R, or 1600 R was made on albino Sprague-Dawley descendant rats. The mean percentage survival of type A spermatogonia surviving was 13.72, 7.75, 4.62, 2.78, and 1.63, respectively, for the above exposures. Nine nonirradiated rats served as experimental controls. The percentage of type A spermatogonia surviving each exposure was calculated and a survival curve plotted with a D_0 estimated as 380 R with a 95% confidence interval of 365 to 395 R and an apparent extrapolation number of 1.12 with a 95% confidence interval of 1.08 to 1.15 R. The low extrapolation number is probably due to the heterogeneity of type A spermatogonia since the extrapolation number obtained is equal to the percentage of resistant type A spermatogonia times the true extrapolation number of the resistant type A spermatogonia. However, the estimated D_0 of 380 R is for the resistant type A spermatogonia. (auth)

32195 RADIOSENSITIVITIES OF SELECTED AMPHIBIANS IN RELATION TO THEIR NUCLEAR AND CHROMOSOME VOLUMES. Sparrow, A. H.; Nauman, C. H.; Donnelly, Grace M.; Willis, D. L.; Baker, D. G. (Brookhaven National Lab., Upton, N. Y.). Radiat. Res.; 42: 353-71(May 1970).

The survival of four species of amphibians (Desmognathus fuscus, Taricha granulosa, Amphiuma means, and Necturus maculosus) was followed after acute x irradiation. Survival parameters were determined from the literature for three additional species (Rana pipiens, Notophthalmus viridescens, and Ambystoma mexicanum). Nuclear volumes and interphase chromosome volumes

were determined from measurements of fixed and sectioned liver cell nuclei. An exposure of 1000 r was 100% lethal for Rana. However, when the latent periods, preceding the time when mortalities increased sharply, were compared by species, it was found that they increased with increased nuclear and/or chromosome volumes. Median survival times after 1000 r also increased with increasing nuclear and/or chromosome volumes. The $LD_{50/20}$ values for Rana, Desmognathus, and Notophthalmus, plotted against ICV, suggest that species with larger chromosomes are progressively more resistant. However, when LD_{50} values were determined at longer times (until radiation-induced deaths ceased), LD_{50} decreased with increasing nuclear and chromosome volumes, as previously found for higher plant species. The LD_{50} for Rana was 724 r at Day 50, and for Desmognathus 530 r at Day 70. Necturus, with the largest nuclear and chromosome volumes of any amphibian known to us, is the most radiosensitive vertebrate thus far investigated, having an LD_{50} of 112 r at 170 days. However, extrapolation of existing data suggests that its LD_{50} at longer times may fall appreciably below this value, i.e., to 76 r at 200 days. (auth)

32196 EFFECTS OF NORETHYNODREL AND EE3ME ON THE INDUCTION OF OVARIAN TUMORS BY IRRADIATION. Sekiyama, A. Horumon To Rinsho, 16: 385-8(May 1968). (In Japanese).

CF-1 strain mice were subjected to a single x irradiation of 150 R at age 20 to 21 days, in order to study the effect of norethynodrel and EE_3ME (ethynyl estradiol-3-methyl ether) at the ratio of 50:1. The incidence of ovarian tumors was followed for periods up to two years. No tumor formation was observed with the control group which received either irradiation and hormone treatment or hormone treatment alone. Ovarian tumors began to appear after about 6 months in 54.55% of the irradiated animals. The irradiated mice which were given the hormone treatment developed tumors only in 31.91% of the cases, indicating some suppression by the norethynodrel and EE_3ME treatment. In view of the histochemical properties of the gonads and ovaries, the oversecretion of gonadotropin seems to play a major role in this tumor formation. (TTT)

32197 RADIATION EFFECTS. Izv. Inst. Morfol., Bulg. Akad. Nauk.; No. 13, 41-51(1968). (In Russian).

Hamsters were exposed to 700 R of x radiation, overheating, and oxygen deficiency. Irradiation and overheating caused swelling of brain cells and destruction of the mitochondria. Oxygen deficiency caused a reduction in size of brain cells. The cell membranes acquired a double contour following all three treatments. Disturbances in phosphorylation processes, ATP synthesis, distribution of inorganic ions, and excitability of neurons were observed. Regeneration processes and formation of new mitochondria began two or three days later; regeneration was associated with intensified electron transport and improved enzymatic function. (Abstr. Bulg. Sci. Lit.)

32198 PARTICIPATION OF HOST FACTORS IN INDUCTION OF LEUKEMIA USING VIRUSES AND RADIATION. Yokoji, K. Nippon Byori Gakkai Kaishi; 56: Suppl., 297-304(1967). (In Japanese).

The effect of certain viruses and/or x and β radiation on the incidence of mouse leukemia was studied by exposing the mice, with or without removing the thymus, and inoculating some of them with Gross Passage A virus. The x-radiation treated mice exhibited a higher incidence of myeloid and lymphoid leukemia than the controls. Irradiation and the Gross virus yielded nearly the same rate of lymphoid leukemia but the myeloid rate was three times higher. Removal of the thymus depressed the incidence of thymic leukemia and increased the rate of the myeloid form. A similar study with the Maloney virus on animals with the thymus removed revealed that the virus did not cause myeloid cases by itself, but resulted in a fairly high incidence of thymic leukemia. The Rauscher virus brought about an incidence of leukemia that was unrelated to the original form; the cases had long latent periods. Similar results were obtained with the Friend virus. Study of the syngenetic transplantability of leukemic cells induced by the Rauscher virus indicated an about 50% transplantability in the C57Bl Ka mice but only 5% in W Fu rats; this may be due to differences in the transplantation antigen. The whole-body x-ray treatment resulted in the highest incidence of leukemia. Injection of ^{89}Sr also caused a high incidence that was further increased by the prior removal of the thymus. A combined treatment with ^{89}Sr and partial exposure to x radiation also caused a high rate of incidence. ^{89}Sr brought about histological changes more slowly than whole-body x-ray treatment but the latter type resulted in a faster rate of recovery. (TTT)

32199 MICROCOLONY SURVIVAL ASSAY FOR CELLS OF MOUSE INTESTINAL MUCOSA EXPOSED TO RADIATION. Withers, H. R.; Elkind, M. M. (Texas Medical Center, Houston). Int. J. Radiat. Biol.; 17: 261-7(1970).

A microcolony technique for assaying the survival of small proportions of the clonogenic cells of the mucosa of the small intestine of mice is described. The radiosensitivity of intestinal crypt cells measured by the technique is the same as that measured by a macrocolony method. However, the microcolony technique has the special advantage of being useful for assaying cell survival after whole-body radiation. If a mouse is exposed to x rays in the dose range of 1000 to 1500 rads, the number of crypts per circumference seen in histological sections $3\frac{1}{2}$ days after irradiation is decreased below the control value of 160. By determining the proportion of surviving crypts after each of a series of graded doses, a relationship between crypt destruction and radiation dose can be established and from that the dose-survival curves for stem cells constituting the crypts. (UK)

32200 VIGILANCE AND NYCTHIMERAL RHYTHMS IN RAT. VARIATION IN IRRADIATED ANIMAL. Cier, A.; Riotte, M. (Centre de Recherches du Service de Sante, Lyon. Univ., Lyon). Arch. Sci. Physiol.; 24: No. 1, 73-80(1970). (In French).

The total body irradiation (800 R to 1200 R) is followed by progressive disappearance of paradoxal sleep phases. The intraperitoneal injection of normal rat serum allows these phases to appear again. The active part of serum is the non-dialyzable fraction. (France) (auth)

32201 ATTEMPT TO ANALYZE THE ELECTRICAL POTENTIALS OF THE CEREBRAL CORTEX BY MEANS OF LOCAL X-IRRADIATION. Roitbak, A. I.; Nadareishvili, K. Sh.; Moiseenko, K. I. Tr. Inst. Fiziol., Akad. Nauk Gruz. SSR; 15: 173-92(1968). (In Russian).

In acute experiments carried out on cats study has been made of the effect of low energy x rays (about 30 kV) on direct electrical response of the cortex (dendritic potential and slow negativity), primary and transcallosal responses and spontaneous activity. At the dose over 30 kR given in dose rate of 40 to 45 kr/min direct electrical responses were found to disappear. Action was local and limited to the irradiated area. At doses of 25 to 30 kR slow negativity was the first to impair and disappear. Dendritic potential could not exhibit any noticeable changes. At higher doses dendritic potential disappeared, too. In this case, even strong electrical stimulation was not effective in producing any responses and there was a violent decrease in its spontaneous activity. But attenuated primary responses, mostly with an initial positive phase, could be recorded. In case of complete cessation of electrical activity stimulation of the irradiated cortex evoked transcallosal responses in the non-irradiated symmetric area. (auth)

32202 ULTRAVIOLET RADIATION THRESHOLDS FOR CORNEAL INJURY IN ANTARCTIC AND TEMPERATE-ZONE ANIMALS. Hemmingsen, E. A.; Douglas, E. L. (Univ. of California, San Diego. Univ. of Missouri, Columbia). Comp. Biochem. Physiol.; 32: 593-600(1970).

The threshold for corneal damage was determined for a series of antarctic and temperate-zone animals. Keratitis was produced in all animals tested. Substantial differences in tolerance levels were found. The thresholds ranged from about 0.3×10^6 to 0.6×10^6 ergs/cm^2 except for the California ground squirrel, which had a higher threshold of 1.5×10^6 ergs/cm^2. The domesticated birds were more sensitive than the antarctic birds, indicating that adaptation of the cornea to uv radiation may be important as protection against snow blindness. Transmission spectra of the cornea showed that the cornea absorbed most of the damaging short wavelength uv radiation, and that absorption was complete above wavelengths which have the most damaging effect, i.e., near 290 mμ. (auth)

32203 MITOTIC SUPPRESSION IN GUT AND GROWTH CARTILAGE BY X-IRRADIATION IN VIVO. Kember, N. F.; Sadek, M. (Royal Free Hospital School of Medicine, London). Int. J. Radiat. Biol.; 17: 19-23(1970).

The occurrence of mitoses in gut and growth cartilage has been recorded at intervals from 2 hours to 24 hours after x-ray doses of 250, 500, 750 and 1000 rads. The delay of mitosis in the gut is roughly linear with dose with a slope of 1.3 ± 0.2 hours/100 rads. In the growth cartilage, there is no clear delay, but the suppression of mitosis lasts for periods similar to those observed in the gut. Abnormal mitoses are common at early intervals after irradiation and their relative numbers increase with dose. (auth) (UK)

32204 THE DYNAMICS OF LIFE. I. DEATH FROM INTERNAL IRRADIATION BY ^{239}Pu AND ^{226}Ra, AGING, CANCER, AND OTHER DISEASES. Stover, Betsy J.; Eyring, Henry (Univ.

of Utah, Salt Lake City). Proc. Nat. Acad. Sci. U. S.; 66: 132-9(May 1970).

Early in the era of atomic energy the potential of plutonium as an industrial and an environmental hazard was recognized. Thus, the Laboratory for Radiobiology was established at this University 20 years ago to compare the effects of plutonium and radium in beagles. Sufficient data have now accrued for exacting analysis. The steady-state theory of mutation rates which provides the necessary formalism to assess the survival data from the ^{239}Pu and ^{226}Ra study was formulated. Although the principal biological end point for both nuclides is the osteosarcoma, the mechanisms of nonsurvival for the two nuclides appear to be different. The success of the theory in this case suggests that application to data on irradiation of more inbred and more outbred species would prove to be exceedingly valuable. (auth)

32205 NATURE OF LATENT CEREBRAL IRRADIATION DAMAGE AND ITS MODIFICATION BY HYPERTENSION. Hopewell, J. W.; Wright, E. A. (St. Mary's Hospital, London). Brit. J. Radiol.; 43: 161-7(Mar 1970).

The cerebral hemispheres of normotensive and hypertensive rats were irradiated using exposures from 1,000 R to 4,000 R. Hypertension was shown to shorten the latent period between irradiation and death for exposures of 2,000 and 3,000 R and to lower the threshold for radiation damage to 1,000 R. Following an exposure of 4,000 R no differential shortening of the latent period occurred, normotensive and hypertensive animals dying after similar lengths of time. The hypothesis is put forward that with low exposures of x rays (2,000 to 3,000 R) radiation death is due to sudden vascular damage while with high values of exposure (3,000 to 4,000 R) death is due to white matter necrosis which follows glial depletion and subependymal stem cell damage respectively. Hypertension only accelerates vascular radiation damage and reduces the effective threshold dose of radiation. The latent period and both modes of damage are explained on the basis of the known slow mitotic replacement of vascular and glial cells in the central nervous system. (auth) (UK)

32206 DIFFERENTIAL EFFECT OF HYDROXYUREA ON HEMOPOIETIC STEM CELL COLONIES IN VITRO AND IN VIVO. Rickard, K. A.; Shadduck, R. K.; Howard, D. E.; Stohlman, F. Jr. (Tufts Univ1 Boston). Proc. Soc. Exp. Biol. Med.; 134: 152-6 (May 1970)

When bone marrow stem cells are assayed simultaneously by the spleen colony technique and the in vitro agar system following treatment of donors with hydroxyurea a differential effect was observed. There was found to be approximately a 50% reduction in the number of bone marrow in vitro colony forming cells after DNA synthesis inhibition by hydroxyurea and only a slight change in the pluripotential stem cell compartment by the spleen colony technique. It appears therefore that the in vitro colony forming cell derives from a proliferating stem cell compartment, probably myeloid committed, and is distinct from the nonproliferating pluripotential transplantable stem cell. (auth)

32207 EFFECT OF EXPOSURE RATE ON THE GASTROINTESTINAL LD_{50} OF MICE EXPOSED TO ^{60}Co GAMMA RAYS OF 250 kVp X-RAYS. Krebs, John S.; Leong, George F. (Naval Radiological Defense Lab., San Francisco). Radiat. Res.; 42: 601-13(Jun 1970).

The LD_{50} in mice due to gastrointestinal radiation injury from exposure to either ^{60}Co gamma rays or 250 kVp x rays was measured for exposure rates ranging from over 100 R/minute down to less than 1 R/minute. The LD_{50} for ^{60}Co gamma rays was greater than the LD_{50} for x rays, but at all exposure rates there was a nearly constant ratio of LD_{50} for the two kinds of radiation. Measurements of rate of recovery of radiation injury were made with x rays, using the split-dose technique. The recovery was exponential, with a half-time of 23 minutes. The amount of repairable injury was about half of the exposure given for exposures up to 470 R, but became nearly constant and independent of exposure between 470 and 700 R. A model for repair of injury during exposure was constructed on the basis of the measured recovery kinetics. The increase of LD_{50} with decreasing exposure rate of either type of radiation was shown to be reasonably accounted for by the model for repair of radiation injury. (auth)

32208 MOTOR ACTIVITY IN VITRO OF RAT SMALL INTESTINE FOLLOWING WHOLE-BODY X-IRRADIATION. Kagnoff, Martin F. (Defense Atomic Support Agency, Bethesda, Md.). Radiat. Res.; 42: 565-76(Jun 1970).

Contractions in vitro of small intestinal segments were studied at varying times following exposure of rats to whole-body x-irradiation. Jejunal contractions were measured 20 to 40 minutes, 4 to 6 hours, 1, 2, 3, 5, 7, 11, and 30 days following 25, 100, and 700 R, as well as during the first 3 days following 1500 R. Duodenum and ileum were studied 2 and 3 days following 1500 R. Sham-irradiated rats served as controls. The irregular contraction pattern characteristic of jejunal segments from nonirradiated rats was changed to a more regular pattern 2 and 3 days after 1500, 700, and 100 R; in addition, exposures with 1500 and 700 R increased contraction amplitude. Two and three days following 1500 R, duodenal, but not ileal segments, showed a significant increase in regularity. Furthermore, the gradient of contraction frequency (duodenum > jejunum > ileum) was maintained, but the gradient of contraction regularity (ileum > jejunum > duodenum) was abolished. Changes in small intestinal motor function following whole-body radiation may significantly contribute to the pathophysiology of intestinal radiation injury. (auth)

32209 EXTRACORPOREAL IRRADIATION OF BLOOD. Suscillon, M. (CEA, Grenoble, France). Bull. Inform. Sci. Tech. (Paris); No. 145, 43-8(Feb 1970). (In French).

A technique for the extracorporeal irradiation of a big animal (the calf) is reported. Some problems concerning the surgical insertion of arterio venous shunt and the irradiation (irradiation prototype, dosimetry) are described in detail. Some results are presented: peripheral blood cytology, serum proteins, blood platelets function and hemolysis before and after irradiation. In the conclusion, an attempt is made to analyze the possibility of this method either in research field or in human therapeutic application. (France)

32210 ULTRAVIOLET AND SOLAR RADIATION. Heinz, K. (Univ., Innsbruck). Ophthalmologica; 158: 75-94(1969). (In German).

Changes in tissue proteins produced by exposure to uv irradiation that included denaturation through changes in chemical bonds, changes in protein conformation, and clinical disease patterns were described. Wavelengths in the range of ~2800 Å produced inflammation maxima at lower levels and sooner than other uv wavelengths. Effects of uv wavelengths of ~2800 Å on protein ion binding, electrostatic changes, and inhibition of RNA and protein formation in skin tissue were discussed. Morphological skin changes were observed usually from 12 to 24 hr after uv irradiation. The uv irradiation entering the eye was almost entirely absorbed by the iris and lens, so that the retina absorbed very little. However, aphakia developed in some cases. Results of studies of uv irradiation effects on rabbit eyes were discussed in detail. The genesis, prophylaxis, and recommended treatment to prevent uv-induced changes in proteins and other tissue constituents were described. (BBB)

32211 INTERNATIONAL REVIEW OF CONNECTIVE TISSUE RESEARCH. VOLUME 4. Hall, David A. (ed.). New York; Academic Press Inc. (1968). 386p. $12.00.

The material is presented in six sections: immunology of collagen, collagen biosynthesis at the ribosomal level; control of collagen biosynthesis; copper and connective tissue metabolism; effect of ionizing radiation on connective tissue components; and physical properties of collagen fibers; an abstract of the latter two appeared in NSA as 23: 18118. Both an author and a subject index are provided. (C.O.)

32212 RADIATION CARCINOGENESIS. Upton, Arthur C. (Oak Ridge National Lab., Tenn.). pp 53-82 of Methods in Cancer Research. Vol. IV. /Busch, Harris (ed.). New York; Academic Press Inc. (1968).

A survey is made of radiation carcinogenesis in laboratory animals, emphasizing techniques, principles, and problems. Topics concerning physical aspects include: ionizing radiations; radioisotopes; radiation dosimetry; radiation sources and exposure techniques; and radiation health protection. Treatment of radiation effects on cells includes radiation chemistry of the cell, and effects on cell survival, chromosomes, genes, mitosis, and nucleic acid synthesis. Oncogenic effects discussed include leukemia, osteosarcoma, tumors of adrenal glands, breast, gastrointestinal tract, kidney, liver, lung, ovaries, pancreas, pituitary, skin, and thyroid, as well as other neoplasms. Discussion of dose-effect relations and the influence of modifying factors includes: incidence in relation to total dose; time-intensity factors; radiation quality; host factors; and cocarcinogenic agents. An extensive bibliography is provided. (C.O.)

32213 EFFECT OF ^{32}P INCORPORATED INTO CHICK EMBRYO. Szabo, L. D.; Antoni, F.; Koeteles, G. J.; Holland, J.; Hidvegi, E. J.; Varteresz, V. (Frederic Joliot-Curie National Research Inst. for Radiobiology and Radiohygiene, Budapest). pp 119-31 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

The biological effects of ^{32}P on the viability and development of chick embryo were studied. 200, 100, and 50 μCi per egg killed the embryos during incubation. Growth retardation preceded their death. Twenty-five μCi per egg, however, did not cause mortality until hatching. An attempt was made to correlate the observed effects with the radiation dose and the number of ^{32}P atoms incorporated into DNA and therefore, the frequencies of radiophosphorus atoms in the polynucleotide chains of DNA and RNA were determined under various conditions. Some biochemical consequences of the decay of ^{32}P incorporated into ribonucleic acids were demonstrated. Structural changes of RNA were observed. Parallel with structural changes, functional alterations of various kinds of RNA molecules were demonstrated in isolated ribosomal systems. The decrease in protein synthesis by liver ribosomes was found to be proportional to the number of decayed intramolecular ^{32}P atoms. The structural and functional changes of ribonucleic acids observed on molecular and subcellular levels could be attributed to nuclear transmutation of ^{32}P. (auth)

32214 EFFECTS OF LOW LEVEL X RADIATION ON THE MITOTIC INDEX OF HAMSTER BASAL EPITHELIAL CELLS IN VIVO. Lurie, Alan (Univ. of Rochester, N. Y.). J. Dent. Res.; 48: Suppl., 1049-53(Nov-Dec 1969).

Chinese hamster cheek pouches were exposed to low doses (0.25 and 5.0 R) of x radiation and to two doses of a metaphase arrester, vinblastine sulfate, in separate experiments. There was no significant decrease in the mitotic indexes of the irradiated animals. The higher vinblastine dose proved to be significantly more effective in causing metaphase arrest. (auth)

32215 THE METHOD OF PARTIAL IRRADIATION AND ITS IMPORTANCE IN THE ANALYSIS OF CHANGES OF REACTIVITY IN IRRADIATED ORGANISMS TO APPLIED DRUGS. Grossmann, Vojtech. (Inst. of Pharmacology, Hradec Kralove, Czech.). Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove; 11: 429-40(1968).

When comparing the results of different laboratories on the reactivity in irradiated organisms to applied drugs it is necessary to plot not only the physical parameters of the x-ray apparatus used, intensity, and HVL, but also the variance of coefficients of absorption in percentage of average coefficient for certifying the homogeneity of beams. The calculation of the absorbed energy dose is very approximate. There is a difference between the absorbed energy in partial and in whole body irradiation. It is lower with partial irradiation (adding the absorbed doses of all parts). The position of the animal during irradiation and the distance of target skin are very important for the final effect. If during partial irradiation the absorbed dose by single parts of the body is equal, the changes in the decay and survival time are greater for the head and abdomen. Comparison of absorbed energy in Rads demonstrates greater sensitivity of the abdomen. Partial irradiation changes the effects of procaine on blood pressure so that there are no basic differences in the importance of single parts of the body, but the integration of these changes is very complex and depends on the quantity of the dose of procaine used. (auth)

32216 STUDIES OF COMBINATION INJURIES: LIFE EXPECTANCY OF MICE RECEIVING SKIN BURNS AT VARIOUS TIMES PRIOR TO AND FOLLOWING WHOLE-BODY IRRADIATION. Messerschmidt, Otfried (Univ., Freiburg i. B.); Langendorff, Hanns; Birkenmayer, Eline; Koslowski, Leo. Strahlentherapie; 138: 619-26(Nov 1969). (In German).

Local burns before irradiation slightly enhanced radiation mortality, while burning after irradiation significantly increased the lethality. Irradiation resulted in a special sensitivity to shock. Subsequent skin burns then provoked the death of the animals. (auth)

32217 VALUE OF SOFT X RADIATION IN RADIATION RESEARCH. I. CONTRIBUTION: DISCREPANCY BETWEEN DIRECT AND INDIRECT X-RAY EFFECTS ON THE RESISTANCE OF SKIN CELLS. DEFINITION OF RADIOINDUCED EPITHELIOLYSIS AS ALARM REACTION FOR UNDERLYING TISSUES. Becker, Olga. Strahlentherapie; 138: 586-92(Nov 1969). (In German).

A clear discrepancy between the direct effect of the energy absorbed within the skin cells and the indirect effect of the energy absorbed in the cells of other organs was demonstrated. The indirect effect had a different course in the skin than the direct effect. It counterbalanced the destructive tendency of the regulation mechanisms of the skin. It provoked an epitheliolysis, that can be considered as an alarm reaction of the skin in favor of the other organs. This particular form of inhibition in the skin is a regulation mechanism of the skin that enhances radioresistance. (auth)

32218 MEDULLARY THYROID CARCINOMA AND PARATHYROID HYPERPLASIA IN RATS. Lindsay, Stuart; Nichols, Clarence W. (Univ. of California, San Francisco). Arch. Pathol.; 88: 402-6(Oct 1969).

The incidence of naturally occurring, medullary thyroid carcinoma was summarized and compared for untreated, 2-yr old Long-Evans and several rat strains with the incidence after x irradiation or ^{131}I treatment. The normal incidence was from 23 to 47%. The incidence of parathyroid hyperplasia in untreated Long-Evans rats ranged from 13% to 57%, but was from 1 to 30% in other rat strains. The incidence of these lesions was not altered by treatment with up to 40 μCi of ^{131}I, nor by x-ray doses of up to 1000 R to either lobe of the thyroid. The expected and observed incidences of both lesions occurring together in the same animal were identical or in the same percentage range, and no significant relation between the thyroid and parathyroid lesions and irradiation was apparent. The expected incidence of medullary thyroid carcinoma and parathyroid hyperplasia occurring together in the same rat was the product of the incidence of each lesion. (BBB)

32219 ELECTRON MICROSCOPIC STUDY OF X-IRRADIATED RABBIT LENSES AND COMPARATIVE STUDY OF THESE RESULTS WITH THOSE OF NEUTRON-IRRADIATED RABBIT LENSES. Konishi, Naoko (Hirsohima Univ.). Nippo Ganka Gakkai Zasshi; 71: 2000-13(Nov 1967). (In Japanese).

The crystalline lenses of young albino rabbits (about 10 weeks old) were x-irradiated (180 kV) at doses of 1000 and 2000 R. The lenses were observed biomicroscopically and by electron microscope after enucleation of the ocular bulb at 5 postirradiation periods: 24 hr, 48 hr, 4 days, 8 days, and later when definite lenticular changes were noted by biomicroscopy. The results were compared with the findings previously reported using fast-neutron irradiation. The initial changes in the lenses of the two x-ray dose groups, as noted by biomicroscopy, were small vacuoles at the anterior subcapsular region and linear opacities at the equatorial region. The latent period was 3 to 8 weeks. The initial changes in the lenses of both x-irradiated groups noted by electron microscopic study 24 to 48 hr after irradiation were reflected by irregular-shaped mitochondria and swollen endoplasmic reticulum in the epithelial cells from the equator. Similar changes were noted 48 to 96 hr after irradiation in the young fibers, but the changes in the epithelial cells from the anterior pole were generally mild. Comparison of these results with those of the fast-neutron irradiated groups failed to demonstrate any qualitative differences in the biomicroscopic and electron microscopic findings. However, quantitatively there was a difference for the 4×10^{10} n/cm^2 (268-Rad) fast-neutron and 1000-R (950-Rad) x-irradiated groups. The 8×10^{10} n/cm^2 (536-Rad) fast-neutron and 2000-R (1900-Rad) x-irradiated groups presented comparable findings. (BBB)

32220 HISTOLOGICAL STUDY OF MICE GONADS TREATED WITH ^{32}P DURING THEIR FETAL LIFE. Penchansky, L.; Gonzalez Cueto, D. (Instituto de Investigaciones Hematologicas, Buenos Aires). Medicina (Buenos Aires), Suppl. 1; 28: 161-4 (Dec 1968). (In Spanish).

Radioactive phosphorus, ^{32}P, administered during fetal life, caused sterility in both male and female mice. The ovary presented follicular aplasia and luteinization of the stroma. The testis showed absence of spermatogenesis and hyperplasia of the Leydig cells. These gonadal alterations have been studied histologically, from birth to adulthood. ^{32}P, in a dose of 60 μCi, was administered intraperitoneally to pregnant mice of the BALB strain, between the 11th and 15th day of gestation. Siblings were sacrificed every 5 days starting 24 hours after birth up to 60 days of age. Histological studies were carried out on the gonads, adrenals, submaxillary glands, and vagina in the females. The following observations were made: there was a complete and permanent damage to the germinal cells in both sexes; the gonads were lesioned in utero apparently during the first 48 hours after the injection of ^{32}P; the picture at birth was that of a reduction in the number of follicles and hyperchromatic nuclei in spermatogonias; on day 10, there was already complete atrophy of the germinal epithelium; disappearance of the follicles started at day 35; apparently, in both sexes, these changes took place during the period of mitotic stimulation, before puberty; interstitial cell hyperplasia occurred in both testis and ovary, a complete luteinization of the ovarian stroma being attained by day 60; secondary sex characters remained normal during the whole period of observation. (auth)

32221 RESPONSE OF OLFACTORY BULB NEURONS TO X RAYS AS A FUNCTION OF NASAL OXYGEN CONCENTRATION. Cooper, G. P. (Univ. of Cincinnati). Science; 167: 1726-7 (27 Mar 1970).

Responses of single olfactory bulb neurons in rats to x irradia-

tion of the head were examined during the perfusion through the nasal cavities of gas containing various concentrations of oxygen. Response to x ray was unchanged with oxygen concentrations of from 100 percent down to about 5 percent. Progressively larger response decrements were observed with oxygen concentrations of two percent and less. (auth)

32222 DELAYED CHANGES IN THE CENTRAL NERVOUS SYSTEM OF RATS IRRADIATED WITH GAMMA RAYS AT 4th DAY OF LIFE. PART II. Ostenda, Maria; Nowakowski, Wladyslaw (Polish Academy of Sciences, Warsaw). Neuropatol. Pol.; 7: 91-7(Jan-Jun 1969).

Four-day-old rats irradiated with a dose of 300 r whole-body γ radiation did not show symptoms of radiation sickness within a period of 3 months observations. Necrotic foci found in the brain 3 months after exposure were undoubtedly of a vascular origin. At the same period, the occurrence of small foci of acid phosphatase activity (lysosomal), SDH, and LDH in the white substance, now and then limited to a few oligoglial cells, may precede the formation of demyelination foci. This would be confirmed if in the later period there were found foci of distinct demyelination. Deposits of glycogen in the white substance are to be considered as a symptom of necrobiotic processes taking place in the tissue, but its character cannot be closely defined. (auth)

32223 PROLIFERATION AND RENEWAL OF SPERMATOGONIA FOLLOWING X IRRADIATION OF THE RAT TESTIS. Dym, Martin. Montreal; McGill Univ. (1969).

Thesis.

The behavior of the two classes of spermatogonial stem cells (A_0 and A_1-A_4) was investigated following 300 R of x rays to rat testes. Radioautographs of cross sections and whole mounts of seminiferous tubules were prepared from animals injected with ^{3}H-thymidine. In nonirradiated controls type A_0 spermatogonia were generally dormant, while type A_1 spermatogonia periodically initiated a series of divisions resulting in the production of spermatocytes and new type A_1 spermatogonia. The numerical ratio of type A_0 to A_1 was approximately 1 : 4. Following irradiation, the number of type A_1 spermatogonia diminished to 3% of controls, reaching this lowest value at the 13-day interval, while the type A_0 cells decreased only to 77% of controls. At this time, the ratio of type A_0 to A_1 cells was 12 : 1. Thereafter, the numbers of type A_0 and A_1 cells progressively increased to return to control values by 39 days. Thus, the type A_0 spermatogonia were the main radioresistant type A. Moreover, after irradiation, the type A_0 cells entered into mitotic division and contributed to the reconstruction of the spermatogonial population partially destroyed. (Disser. Abstr.)

32224 CORRELATION BETWEEN PHAGOCYTIC INDEX K AND SURVIVAL TIME IN X-IRRADIATED MICE. Flemming, Kurt; Flemming, Christa (Heiligenberg Institut, Baden, Ger. Univ., Freiburg i. B.). Strahlentherapie; 138: 611-13(Nov 1969). (In German).

A possible relation between individual radiosensitivity and an increased phagocytosis was studied in mice, by measuring a clearance index for carbon particles (8 or 16 mg of carbon for 100 g body weight). The clearance rate K was determined 5 days after a total-body irradiation. The day of death was noted for each animal. So a negative correlation was found between an increase of the K value and the survival. The increase of the K value is not due to an increase in phagocytic function of the reticulo-endothelial cells, but is due to a lesion caused by the radiation. The injected carbon is not only taken up by these cells, but also penetrates other organs. (auth)

32225 EFFECT OF ADRENALECTOMY ON THE RESPONSE OF RAT LIVER POLYRIBOSOMES TO WHOLE-BODY GAMMA RADIATION. Yatvin, M. B. (Univ. of Wisconsin, Madison). Experientia; 26: 253-4(15 Mar 1970).

Rats were adrenalectomized and given injections of homogenized adrenal glands as replacement therapy. One group of these rats and a group of intact control rats were given 900 R of whole body ^{137}Cs γ radiation. A graph is presented to show polyribosome patterns of the livers of the three groups of rats. A marked shift was observed in polyribosome species of intact rats 20 hr after radiation. In contrast, no response was obtained in the liver of adrenalectomized, irradiated rats. The results suggest that the effect of radiation on liver polyribosomes is regulated, at least in part, by the adrenal glands. (H.L.W.)

32226 INDUCTION OF HEMATOPOIETIC NEOPLASMS IN MINIATURE SWINE BY CHRONIC FEEDING OF ^{90}Sr. Howard, Edwin B.; Clarke, William J. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. J. Nat. Cancer Inst.; 44: 21-38(Jan 1970).

Chronic oral exposure to strontium-90 induced a spectrum of hematopoietic disorders in miniature swine. These leukoproliferative conditions affected 49 animals with myeloproliferative disorders including myeloid metaplasia and myeloid leukemia, 17 with lymphoma or lymphocytic leukemia, and three with stem cell leukemia. In the same experiment, bone sarcomas were observed in seven animals. Myeloid leukemia was observed in 2 control pigs. No lymphomas were seen in the controls. These results indicate that chronic strontium-90 exposure, resulting in uniform skeletal deposition, affects the hematopoietic tissue much more than the bone. (auth)

32227 EVIDENCE FOR THE EXISTENCE OF MULTIPOTENTIAL LYMPHO-HEMATOPOIETIC STEM CELLS IN THE ADULT RAT. Nowell, Peter C.; Hirsch, Bruce E.; Fox, Dianne H.; Wilson, Darcy B. (Univ. of Pennsylvania, Philadelphia). J. Cell. Physiol.; 75: 151-8(Apr 1970).

Rats were given near-lethal doses of x rays to produce clones of hemic cells marked by radiation-induced chromosome abnormalities. Subsequently, bone marrow from these rats was injected into lethally irradiated mice to form erythropoietic spleen colonies; and peripheral blood lymphocytes from the same rats were stimulated to proliferate in a mixed lymphocyte interaction (MLI), an immunological response to histocompatibility isoantigens. Chromosome markers indicated that in several instances the cells of an erythroid spleen colony and a proportion of the lymphocytes reacting in the MLI were progeny of the same stem cell in the donor rat. In addition, lymphocytes of the same radiation-marked clone were shown to proliferate in response to several different histocompatibility isoantigens. The data indicate the presence in the adult rat of a primitive lympho-hematopoietic stem cell capable of yielding both erythroid and lymphoid progeny. The findings also suggest that immunological specificity is determined during lymphoid differentiation, subsequent to the stem cell stage. (auth)

32228 DENSITY DISTRIBUTION ANALYSIS OF IN VIVO AND IN VITRO COLONY FORMING CELLS IN BONE MARROW. Haskill, J. S.; McNeill, T. A.; Moore, M. A. S. (Walter and Eliza Hall Inst., Melbourne). J. Cell. Physiol.; 75: 167-80 (Apr 1970).

The technique of buoyant density separation in gradients of Bovine Serum Albumin has been used to separate hemopoietic cell populations in mouse bone marrow that form in vivo spleen colonies and in vitro colonies of granulocytes and macrophages in an agar culture system. The density distribution profiles showed a number of reproducible density subpopulations of both in vivo and in vitro colony forming cells (C.F.C.'s). The mean density of in vitro C.F.C.'s exceeded that of the in vivo but overlap of the density profiles of the two populations was evident. Density-related differences in seeding efficiency of in vivo C.F.C.'s were observed. Freund's adjuvant treatment increased marrow and spleen in vitro C.F.C. populations. Marrow density profiles obtained three and seven days after adjuvant showed a progressive increase in in vitro C.F.C.'s in a restricted density region with no associated elevation of in vivo activity. The antimitotic agent, vinblastine, revealed differences in mitotic activity between the two cell populations, reducing the in vitro C.F.C. population to .07% and the in vivo to 5% of normal in 24 hours. Density separation of vinblastine-treated marrow produced density regions devoid of in vitro activity but containing in vivo C.F.C.'s which, upon transfer to irradiated recipients, regenerated both in vivo and in vitro density distribution profiles. (auth)

32229 DENSITY DISTRIBUTION ANALYSIS OF IN VIVO AND IN VITRO COLONY FORMING CELLS IN DEVELOPING FETAL LIVER. Moore, M. A. S.; McNeill, T. A.; Haskill, J. S. (Walter and Eliza Hall Inst., Melbourne). J. Cell. Physiol.; 75: 181-92 (Apr 1970).

The technique of buoyant density separation in gradients of Bovine Serum Albumin has been used to separate in vivo and in vitro colony forming cells (C.F.C.'s) in hemopoietic tissue of mouse fetal liver. Differences in the density distribution profiles showed that the in vivo and in vitro C.F.C.'s were different cell populations but the existence of an "out-of-phase" density association suggested that the two cell types were closely related. Complex density heterogeneity of both cell populations was observed at later stages of liver development and was similar to that seen in adult marrow. A homogeneous population of in vivo and in vitro C.F.C.'s occupied a very light density position in 10.5 day fetal liver. The subsequent development of density heterogeneity was associated with progressive acquisition of higher density subpopulations. Transfer experiments showed the capacity of the lightest density cells from the earliest stage of liver hemopoiesis, to generate higher density colony forming cells in the environment of the adult marrow. Density determined differences in seeding efficiency of in vivo C.F.C.'s were observed but no evidence was obtained for differences in either in vivo or in vitro colony morphology in different density subpopulations. (auth)

32230 DIFFERENTIAL PROLIFERATION OF ERYTHROID AND GRANULOID SPLEEN COLONIES FOLLOWING SUBLETHAL IRRADIATION OF THE BONE MARROW DONOR. Wolf, Norman S.; Trentin, John J. (Baylor Coll. of Medicine, Houston, Tex.). J. Cell. Physiol.; 75: 225-30(Apr 1970).

Spleen colonies produced by sublethally irradiated mouse bone marrow cells were compared to those produced by unirradiated marrow cells in lethally irradiated mice. Sublethally irradiated marrow cells gave rise to many fewer spleen colonies. At seven days of colony age, the ratio of erythroid colonies to granuloid colonies was lower (<1) than for colonies formed by unirradiated marrow (2 to 3 or more). Delay of harvest of colonies to day 10 or 12 resulted in 6 to 11 fold increase in the ratio of erythroid to granuloid colonies due largely to the belated appearance of erythroid colonies. (auth)

32231 THE INFLUENCING OF POST-TRAUMATIC HAEMORRHAGE BY ELLAGIC ACID IN RATS WHOLE-BODY IRRADIATED WITH 600 R. Pospisil, Jan; Skala, Evzen; Dienstbier, Zdenek (Charles Univ., Prague. Central Military Hospital, Prague). Strahlentherapie; 138: 607-10(Nov 1969).

In rats whole-body irradiated with 600 R of x rays, it was found that ellagic acid administered in the dose 2×10^{-4} M-10ml/kg, decreased the post-traumatic hemorrhage as compared with whole-body irradiated animals under the same conditions, but without administration of the compound. This effect was found on days 9, 11, and 13 after irradiation. (auth)

32232 EXPERIMENTAL RADIOTHERAPY OF A RAT RHABDOMYOSARCOMA WITH 15 MeV NEUTRONS AND 300 kV X-RAYS. II. EFFECTS OF FRACTIONATED TREATMENTS, APPLIED FIVE TIMES A WEEK FOR SEVERAL WEEKS. Barendsen, G. W.; Broerse, J. J. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Eur. J. Cancer; 6: 89-109(1970).

Experiments were carried out to evaluate responses of a rhabdomyosarcoma, transplantable in an inbred strain of rats, to various daily doses of 300 kV x rays and 15 MeV neutrons applied five times per week for different numbers of weeks. Tumor growth delay and loss of cell reproductive integrity during and after treatments were compared in order to gain an insight in the relative importance of various factors which determine the effectiveness of different treatment schedules, namely intracellular repair of sub-lethal damage, the presence of anoxic cells and their re-oxygenation during intervals and repopulation of tumors through proliferation of surviving cells. The results show that tumor volumes change to a much smaller extent than the fractions of cells which have retained the capacity for unlimited proliferation. During treatments of three or more weeks the effectiveness of a given daily dose for the reduction of the numbers of clonogenic cells is shown to vary. After the end of treatments applied five times a week for three weeks with daily doses of 50, 70, or 100 rads of 15 MeV neutrons and 200 or 300 rads of 300 kV x rays, the surviving cells proliferate with a doubling time of about 2 days as compared with 4 to 5 days before irradiation. RBE-values of 15 MeV neutrons for fractionated irradiations are shown to be dependent on the schedules compared. (auth) (UK)

32233 SIGNIFICANCE OF THE BURSA OF FABRICIUS AFTER WHOLE-BODY X IRRADIATION. Sato, Koji; Suzuki, Kunihiko (Nagoya Univ., Japan). Poultry Sci.; 48: 1195-8 (Jul 1969).

Data are presented that indicate that an intact bursa is essential for the rapid recovery of antibody potential after x irradiation. White Leghorn males were submitted to surgical bursectomy at 3 weeks of age. Ten days after the operation, chicks were x irradiated with 520 or 712 R. Two weeks after irradiation, bovine serum albumin (BSA) (40 mg/kg body weight) and sheep red blood cells (SRBC) (0.5 ml of 15% suspension) were simultaneously injected. The blood was taken 7 days after injection, and serum precipitin and anti-SRBC agglutinin titers were determined. Bursectomy at 3 weeks of age did not impair precipitin and anti-SRBC formation, whereas additional x irradiation severely impaired antibody formation. These data suggest that the presence of the bursa of Fabricius is important for restoration of antibody formation after irradiation. The relative resistance of anti-SRBC formation to x irradiation was observed. (BBB)

32234 HISTOCHEMICAL PECULIARITIES OF RADIORESISTANT AND RADIOSENSITIVE TUMORS. Efimov, M. L.; Yakovleva, S. S.; Ismailov, B. I. (Kazakh Inst. of Oncology and Radiology, Alma-Ata, USSR). Vop. Onkol.; 15: No. 10, 94-6(1969). (In Russian).

In the radioresistant rat ovary ascitic tumors and in radiosensitive Plisse lymphosarcoma, histidine, arginine, acid protein, and the isoelectric point of the nucleus and cytoplasm were investigated cytochemically. The increased concentration of histidine and arginine and reduced acid protein were found in ovarian tumor cells. The possible role of the main amino acids in radioprotective effects is discussed. (auth)

32235 EFFECT OF TESTOSTERONE-PROPIONATE ON THE DEVELOPMENT OF PRETUMOR CHANGES AND INCIDENCE OF TUMORS IN IRRADIATED MICE OVARIES. Gubareva, A. V. (Central Research Roentgeno-Radiological Inst., Leningrad). Vop. Onkol.; 15: No. 10, 89-93(1969). (In Russian).

The effect of persistent and continuous injections of testosterone-propionate on the course of pathological processes and incidence of tumors in ovaries of irradiated mice has been studied. Non-pedigree (virgin females) were γ irradiated (GUT-Co-60-400) in a dose of 200 R. Testosterone-propionate injections (each 1.25 mg) were made percutaneously daily during the whole period of the animal's life. The first injection was made 2 to 3 days after the irradiation. Persistent and continuous injections of testosterone-propionate were accompanied by only temporary (up to 5 to 6 months) inhibition of hyperplastic process development in mouse ovaries sterilized with ionizing radiation and neither reduced the tumor incidence in such ovaries, nor elongated the latent period of formation. (auth)

32236 INFLUENCE OF RADIOACTIVITY OF SKIM MILK ON LIVING BODIES. Tanaka, Tetsuya (Mie Prefectural Univ., Tsu, Japan). Mie Med. J.; 18: 259-71(Jan 1969).

An experiment was performed with mice to study the effects of radioactive nuclides contained in the feed skim milk. A total of 52 mice, including 35 males and 17 pregnant females, were divided into 5 groups according to the radioactivity of the given feed; 24, 72, 192, 240 m μc and higher than 480 m μc. The radioactive nuclides included were ^{90}Sr, ^{137}Cs, ^{95}Zr and ^{40}K similar to those in natural cow's milk. Of 17 female mice, only one that was given feed with 24 m μc radioactivity showed no sign of abnormality in its nine fetuses; fetuses in other 16 mice were found dead. The leukocyte count in 24 m μc fed mice was approximately half of the normal value. In mice given 72 m μc feed, atrophy of the pancreas and also of the thymus with secondary small lymph nodes and rapid fatty degeneration was observed. A comparative study with x-ray irradiation as well as injection and intake of radioactive rainwater indicated the radioactivity of the three in the increasing order of x-ray irradiation, radioisotopes and radioactive rainwater. It is concluded that the effects of the intake of radioactive skim milk are similar to those induced by radioactive rainwater. (NSA of Japan)

32237 PROLIFERATION OF PLASMA CELLS IN THE SPLEEN OF X-IRRADIATED MICE AND TRANSPLANTED WITH LYMPH NODE CELLS. Nakamura, Kunie; Hanaoka, Masao (Kyoto Univ.). Annu. Rep. Inst. Virus Res., Kyoto Univ.; No. 11, 28-31(Dec 1968).

Plasma cells are known to be resistant in vivo to severe irradiation and to increase in number in lymphoid tissue after x irradiation. Plasma cells also proliferate massively in the spleen of mice which are x irradiated and injected with lymph node cells. Experiments were performed in order to know whether these plasma cells derived from the donor's lymph nodes or from the host's spleen. Adult donor mice were injected with HGG or typhoid-paratyphoid vaccine. Over 90% of the lymph node cells of mice injected intraperitoneally with a total of 2.25 μC of ^{3}H-TdR/g body weight were labeled in ^{3}H-autoradiography on smear preparations. Ten $\times 10^{6}$ living cells in suspension, obtained from mesenteric, axillary and cervical lymph nodes, thymus, bone marrow or peritoneal cavities of untreated or immunized donors, were injected intravenously into each recipient, which had been previously x irradiated with 1,000 R (250 kV, 20 mA, 60 R/min, 1.0 mm Al and 0.5 mm Cu filters) within 24 hr. Control mice were irradiated with the same dosage of x ray and without cellular transfer. Almost all the plasma cells proliferating in the spleen had no grains in the nuclei of recipients injected with labeled lymph node cells. In immunofluorescence, there was no plasma cell containing anti-HGG antibody in the spleens of recipients injected with lymph node cells of donors immunized with HGG. These findings show that the proliferating plasma cells in the recipient's spleen derived from the recipients themselves, and that even untreated lymph node cells can induce proliferation of plasma cells in the recipients' spleens, although immune lymph node cells were more effective than the untreated ones. However, no proliferation of plasma cells was found in the recipients' spleens injected with peritoneal macrophages of mice, which were hyperimmunized with vaccine or immunized with HGG. These findings suggest that lymph node cells may play an important role in inducing proliferation of plasma cells. (NSA of Japan)

32238 ELECTROLYTE METABOLISM IN MICE DYING FROM THE GASTROINTESTINAL SYNDROME AFTER WHOLE-BODY IRRADIATION. Mathieu, O.; Gerber, G. B. (EURATOM, Mol, Belgium. SCK-CEN, Mol, Belgium). Atomkernenergie; 15: 71-3(1970).

Turnover of ^{22}Na and $^{3}H_2O$ was studied in mice subjected to a whole-body x irradiation with doses causing gastrointestinal death. Loss of Na^+ from the body was found to be less than 15% of the body pool and sodium concentration in the body of irradiated starved animals was only slightly lower than that of nonirradiated starved mice but higher than that of nonirradiated fed mice. The gastrointestinal tract of irradiated animals contained somewhat more Na^+ than that of nonirradiated ones, but this excess was less than 5% of the body pool. Moreover, Na^+ loss occurred only on the fourth day after exposure, that is at a time when many animals had already died. It is concluded, that loss of Na^+ is not the sole or even the principal cause of death from the gastrointestinal syndrome after irradiation. (auth)

32239 EFFECTS OF RADIOTHYROIDECTOMY BY ^{131}I ON THE SELF-SELECTED CIRCADIAN RHYTHM OF REST AND ACTIVITY IN THE CANARY. Wahlstroem, Goeran (Univ. of Uppsala). Acta Soc. Med. Upsal.; 74: 161-78(1969).

The effects of administration of 60 to 200 μCi of ^{131}I according to various dose schedules on the physical activity of canaries (Serinus canarius) were studied. Treatment with ^{131}I decreased the duration of activity and circadian period. The duration of rest was increased. The decrease in the duration of the circadian period depended on the pretreatment value. In birds with long circadian periods the decrease was large. Approximately 1 yr after the start of the ^{131}I treatment all birds tended to have the same duration of the circadian period. No similar plateau was found for activity and rest. No fixed pattern of changes in activity and rest that always accompanied the changes in circadian period was found. L-Triiodothyronine (6 to 10 mg/kg orally as a single dose) given late in the activity to hypothyroid birds caused an increase in the circadian period. In the first periods after the dose the duration of rest was increased but later on it was decreased. This increase in rest did not occur in normal birds. With this exception the induced changes were similar but larger and had a longer duration compared with changes induced in normal birds. The possibility of thyroid hormones as modulators of the normal self-selected circadian rhythm is discussed. Differences in thyroid activity may explain differences in the duration of the circadian period between different birds. (BBB)

32240 MORPHOLOGICAL CHANGES IN RAM SPERMATOZOID STORED IN VITRO UNDER DIFFERENT CONDITIONS. Smagulov, Sh. B.; Martynov, Yu. F. (Inst. of Experimental Biology, Alma-Ata, USSR). Izv. Akad. Nauk Kaz. SSR, Ser. Biol.; No. 3, 77-80 (1968). (In Russian).

Electron microscopy of the morphological changes in spermatozoa of rams (in vivo and in glucose-yoke-citrate solution) was used to study effects of 10, 50, 100, 500, 1000, and 2000 R x-ray doses. In in vivo spermatozoa disturbance of perforation was only 6.3%, which did not affect the fertilization of female sheep. The storage of sperm in glucose-yoke-citrate solution at 0°C induced disintegration of perforation that increased with time. X-irradiation produced negative effects on the spermatozoa perforation with the percentage of disturbance increasing with increase of dose. (R.V.J.)

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Refer also to abstracts 31464, 31909, 31910, 31920, 31939, 31955, 31959, 32021, 32027, 32033, 32047, 32125–32127, 32133, 32134, 32139, and 32140.

32241 SPLENIC IRRADIATION IN CHRONIC GRANULOCYTIC LEUKEMIA: CHANGES IN LEUKOCYTE VALUES. Comas, F. V.; Edwards, C. L.; Vodopick, H. (Oak Ridge Associated Universities, Tenn.). Radiat. Res.; 42: 413-23(May 1970).

Thirteen patients with chronic granulocytic leukemia were given 28 separate irradiations to the spleen. The radiation was given as a single dose that ranged between 100 and 700 rads. The changes in the circulating white blood cell (WBC) count were represented by the expression $N = B_0 + S_0(e^{-\beta t})$ where N is the number of WBC per mm^3 of blood at day t; S_0 is the number of WBC, at time zero, originating from the spleen; and B_0 is the number of WBC stemming from nonirradiated parts of the body, mostly bone marrow. The disappearance rate β, determined by an indirect method, indicated that S_0 cells were leaving the blood with a half-time of 4.5 days. The number of S_0 cells could be calculated a posteriori by the expression $S_0 = (N_0 - N)/(1 - e^{-\beta t})$, where N_0 is the number of WBC before spleen irradiation and N the number of WBC at t days after irradiation. (auth)

32242 FUNCTIONAL CHANGES OF THE VESTIBULOCOCHLEAR ANALYZER CAUSED BY RADIATION. Kasparek, I.; Zamecnik, J. (Onkologicky Ustav, Prague). Cesk. Otolaryngol., 18: 12-18(Feb. 1969). (In Czech).

Examination of patients given therapeutic doses of radiation for destruction of tumors in regions such that the inner ear was also exposed to radiation during the therapy showed that changes had also occurred in the vestibulocochlear analyzer. Tests on this structure showed that improvement in sensation had occurred as a result of both opening up of an occluded tube and of direct action on the sensory cells. Unilateral doses of 7000 R always resulted in deterioration. Irradiation decreased the vestibular analyzer sensitivity, but function later returned to normal. With doses of up to 4000 R, late postirradiation functional changes were not observed in the vestibulocochlear analyzer. (TTT)

32243 EFFECT OF PYATIGORSK RADON WATER ON SEVERAL INDICES OF THE FUNCTIONAL STATE OF THE OVARIES IN UTERINE MYOMA. Aleksandrova, V. P. Akush Ginekol., 43: 53-6(Dec. 1967). (In Russian).

Natural radon water was used for the treatment of functional disturbances in 110 women, aged under 40 years, suffering from uterine myoma. The patients received radon baths — 15 to 16 procedures per course. The total absorbed radiation dose was 13.6 rad. A study of the hormonal activity of the ovaries by means of functional tests showed that normal hormonal activity of the ovaries is not affected by radon baths. In disturbed hormonal activity there was a regulating effect. (auth)

32244 EARLY RADIATION INJURIES OF THE URINARY BLADDER IN COMBINED RADIOTHERAPY OF CANCER OF THE CERVIX UTERI. Rodovich, V. S. Akush. Ginekol., 43: 35-8(July 1967). (In Russian).

The state of the mucous membrane of the urinary bladder was investigated after combined radium treatment of 120 patients suffering from cancer of the uterine cervix. Reactions and injuries of the mucous membrane of the urinary bladder occurred in 42 patients and consisted in the appearance of local hyperemia (15.00%), diffuse hyperemia (15.83%), elevated susceptibility to injury (15.00%), the appearance or intensification of hemorrhages (3.33%), edema (15.83%), radium-induced epithelitis (3.33%), ulcerous process, ischemia and the so-called pseudotumor (0.83%). Radiation injuries ran a course clinically as cystitis of diverse severity: mild (15.00%), median (4.16%), severe (1.66%). The greatest number of cystitis developed after the second month of treatment of uterine cervix carcinoma and after the cessation of treatment. (auth)

32245 SIMPOSIO SOBRE AS RADIACOES IONIZANTES E O FUTURO DA ESPECIE HUMANA, RIO DE JANEIRO, BRASIL. (Symposium on Ionizing Radiation and the Future of the Human Species, Rio de Janeiro, Brazil). An. Acad. Brasil. Cienc., 39: Suppl., 1-175(Dec. 31, 1967). (In Spanish and English). (CONF-670709).

Separate abstracts were prepared for seven papers. Two other papers and an introduction were included in the symposium. (C.O.)

For abstracts of individual papers see: 31773, 31909–31911, 32246, 32274, and 33352.

32246 RADIATION AND CARCINOGENESIS. Upton, Arthur C. (Oak Ridge National Lab., Tenn.). An. Acad. Brasil. Cienc., 39: Suppl., 129-61(Dec. 31, 1967).

From Symposium on Peaceful Uses of Atomic Radiation, Rio de Janeiro, Brazil. See CONF-670709.

An association between irradiation and neoplasia has been detected in human populations at lower levels of radiation exposure and in a greater variety of neoplasms than hitherto suspected. The dose-incidence relation cannot, however, be specified precisely for any neoplasm. Furthermore, the oncogenic effects of radiation appear to depend on the age of the population at the time of exposure. The carcinogenic effects of radiation in animals appear diverse and complex. The degree to which the process carcinogenesis may involve indirect effects on the host, as well as direct effects on the tumor-forming cells themselves, cannot be specified. In many instances, neoplasia apparently involves interactions among the effects of radiation, viruses, chemicals, and various host factors. (auth)

32247 CLINICAL COURSE OF SEVERE RADIATION INJURY OF THE COLON AND RECTUM. Moeller, Carl; Mellin, Lars (Univ., Helsinki). Ann. Chir. Gynaecol. Fenn., 57: 551-6(1968). (In German).

Twelve cases of heavy radiation damage to the colon and rectum leading to hospitalization are discussed. The patients had received elevated radiation dosages. The clinical course differed. Spontaneous remissions could be observed in rather advanced cases, but on the other hand there were instances of increasing bowel-constriction and lethal hemorrhage. Special attention should be paid to any involvement of the bladder and ureters. (auth)

32248 THE SCINTILLATION CAMERA-1600 CHANNEL ANALYZER IN THE EVALUATION OF LIVER, GALLBLADDER, AND KIDNEY FUNCTION. Fukuda, Masashi; Torizuka, Kanji;

Hamamoto, Ken; Fujii, Masahiro; Morita, Rikushi; Kosaka, Tadako (Kyoto Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 350-2(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The performance of a scintillation camera for scanning the gallbladder, liver, and kidneys using iodine-131-labeled compounds was evaluated. Good results in organ visualization and changes in uptake as a result of various disease conditions were obtained using injected or ingested ^{131}I-labeled rose bengal for gallbladder and liver and ^{131}I-labeled hippuran or iothalamate for kidney scanning. The liver uptake of ^{131}I-labeled rose bengal was calculated from an analysis of the total radioactivity curve obtained using a second scintillation detector placed on the patient's head. (C.H.)

32249 TREATMENT OF SCALP RINGWORM WITH X-RAY MAY BE LINKED TO CANCER AND MENTAL ILLNESS. Public Health Rep. (U.S.); 85: 205(Mar 1970).

A research program is investigating a possible relationship between x-ray treatments administered to more than 20,000 young people in Israel 10 to 20 years ago and incidence of mental and nervous diseases and cancer. During the study, investigators will contact young people who were treated for tinea capitis to obtain medical histories, study hospital records of the irradiated group for detailed information on the occurrence of cancer and mental and nervous diseases, and compare disease incidence for the study group with a nonirradiated control group. (H.L.W.)

32250 PERITONEAL THOROTRASTOSIS. Holle, J. (Kaiser-Franz-Joseph-Spital, Vienna). Zentralbl. Allgem. Pathol. Pathol. Anat.; 111: 495-500(1968). (In German).

Characteristics and symptoms of peritoneal thorotrastosis in a 70-yr-old patient that had received ThO_2 21 yr previously were studied and described in detail. Numerous areas of contrast were observed radiologically, disseminated throughout the abdomen and pelvic region. The particles were found free and incorporated in macrophages in the appendix and mesentery. Localized thorotrastomas with hyalinized connective tissue were seen, but no foreign-body giant cells or inflammatory reactions were observed. The presence of α particles was clearly demonstrated in the tissues. The pathological and anatomical findings were briefly compared with results obtained from experimental animal studies of peritoneal thorotrastosis. (BBB)

32251 INJURIES TO LOWER ABDOMINAL ORGANS AS A COMPLICATION OF RADIOTHERAPY. Oei, L. Ong; Roth, A. (Humboldt-Univ. Berlin, Germany). Z. Aerztl. Fortbild.; 61: 234-40(1 Mar 1967). (In German).

Early and late irradiation injuries of the gastrointestinal tract, bones, skin, and urinary tract that resulted from x-ray treatment were discussed. These included ureteral stenosis, ulceration of the intestine, vagina, or bladder, and fistulation from combination treatment with Ra and percutaneous x or ^{60}Co γ irradiation. The effects of irradiation dose level, amount of irradiation energy absorbed, and radiation quality for ^{60}Co γ, 200-KV x-ray, and ultrahard x-ray were discussed. Examples of irradiation injuries produced were presented. To avoid injuries of pelvic connective tissues, biaxial ^{60}Co irradiation was recommended for treatment of cervical carcinoma, provided that the total dose did not exceed 6000 R in the space of the 80% isodose. Urinary tract irradiation injuries were reported in 20 to 25% of treated patients, of whom ~1/2 died later of uremia. High irradiation doses produced osteoporosis, and in from 1 to 2.75% of patients irradiated in the hip joint area osteoradionecrosis and spontaneous fractures developed. The fractures appeared from 6 to 23 months after irradiation with doses of more than 5000 to 6000 R. Chronic, radiogenic skin ulcers were observed 10 yr after surface doses greater than 6500 R had been given. The clinical history was described of a patient who suffered from almost all of the injuries possible after treatment with irradiation for a gynecologic tumor. (BBB)

32252 RADIATION INJURY OF PHARYNX AND LARYNX; RADIATION CANCER AND LARYNGITIS DUE TO RADIOTHERAPY. Gerlings, P. G. (Univ., Utrecht). Ned. Tijdschr. Geneesk; 113: 1045-50(14 Jun 1969). (In Dutch).

Cancer and other symptoms that appear after radiation treatment for tuberculosis of the neck glands or for a thyroid condition are described. The locations of the cancers, which appear some 10 to 45 (an average of 25) years after irradiation, vary with the area of the neck originally irradiated: in the sinus piriformis of the pharynx, postcricoidal cancer, or cancer in the cervical esophagus, depending on whether the irradiated area is located high or lower on the neck, or lies around the thyroid. Other symptoms frequently include swallowing difficulties, hoarseness, swellings, and metastases of the neck glands (usually on the unirradiated side, most of the glands on the treated side having been destroyed), scarring and occasionally festering and fistulas of the irradiated skin, and swollen, inflamed, stiffened, or atrophied vocal chords. Patients irradiated between 1925 and 1935 have shown breathing difficulties and ischemia of the cerebrum due to the virtual strangulation of the breathing apparatus as well as the large blood vessels of the neck. Benign forms of radiation trauma, which have appeared as early as 6 years after radiation, include changes in the epithelial tissue: atrophy, teleangiectasia, and perichondritis. It has usually been impossible to determine the original radiation dosages; most must have been well over 3000 R, but many much greater. The general practitioner is cautioned to be on the lookout for cancer of the neck following radiation, and questions the use of radiation treatment for any operable tumor in the ENT area. Many illustrations in support of individual case histories are provided. (C.O.)

32253 THORIUM DIOXIDE GRANULOMA OF THE NECK. A DIAGNOSTIC AND THERAPEUTIC CHALLENGE. von Leden, Hans (Univ of Southern California, Los Angeles). Arch. Otolaryngol.; 91: 520-3(Jun 1970).

A patient with thorium dioxide granuloma of the neck had hoarseness as the only presenting symptom, 17 years after the injection of thorium dioxide (Thorotrast) into the left carotid system for angiography. (auth)

32254 LEUKEMIA IN RADIOLOGICAL WORKERS AND IN PATIENTS TREATED WITH IONIZING RADIATION (WEST JAPAN). Wakisaka, Gyoichi; Kariyone, Shigeo (Kyoto Univ.). Nippon Ketsueki Gakkai Zasshi; 43: 792-804(Oct 1968). (In Japanese).

Twenty-five cases of leukemia in radiologists and physicians and 28 cases of leukemia developing after radiotherapy were collected from 500 hospitals in western Japan from 1960 to 1967. These collected cases were examined, and their characteristics and the relation of ionizing radiation to hematological aspects are discussed. In the leukemia in radiologists and physicians, 44.0% cases were acute myelogenous leukemia (AML) and 40.0% chronic myelogenous leukemia (CML). The incidence of CML was significantly higher than AML when compared with that for all cases of leukemia in Japan. On the other hand, in leukemia after radiotherapy 58.6% cases were AML and 28.0% CML. There was no significant difference from the incidence of leukemia for all Japan. The ages of patients with acute and chronic radioinduced leukemia were distributed evenly between 20 and 60 yr, while in other cases of leukemia the incidence of the acute form was significantly higher than that of the chronic form at younger ages. The latent period of radiation leukemia in radiologists and physicians was 11.37 yr on the average, and that of leukemia after radiation therapy was 3.92 yr. The latter was significantly shorter than the former. A relation between latent period and radiation dose was not clearly evident. There was no differences in hematologic picture between radiation leukemia and other leukemias. However, only few cases of the aleukemic type were observed in radioleukemia. The clinical course of radioleukemia from onset was found to be completely the same as that observed in other acute and chronic leukemias. (BBB)

32255 THE PRESENT STATUS OF LASER IN MEDICINE. Siler, Vinton E. (Univ. of Cincinnati). Postgrad. Med.; 46: 82-6(Aug 1969).

Laser instrumentation, biological effects, and therapeutic applications are reviewed. A significant thermal factor characterizes the laser reaction in tissue, the heat spreading from the target area by conduction, convection, and radiation. The brief duration of the laser impact plus the low thermal conductivity of tissues gives a sharply demarcated reaction, especially in pigmented tissues. The reaction is thus limited to focal coagulation necrosis and does not affect adjacent vital structures, such as major blood vessels, nerves, and bones. With pulsed laser impaction, charring and vaporization are evident grossly. Microscopically, there is intense coagulation necrosis of the tissue. Cellular membranes are ruptured and cellular structure distorted, similar to changes following thermal cautery. In the second phase of this laser reaction, the high-energy impact on tissues produces elastic stress and recoil waves. Laser heating causes cellular expansion, bursting the cell membranes. At the same time, sudden vaporization of surface tissues develops recoil pressure changes that hinder cellular necrosis. In the third phase, interaction of the enormous electromagnetic fields of the light beam produces free electrons and ionized atoms and molecules. Pigmented cells absorb selectively at certain laser wavelengths. The location of blood vessels, blood flow, and concentrations of oxygen and hemoglobin also may have an influence on the absorption of laser radiation. (BBB)

32256 THE EFFECT OF THE NERVOUS SYSTEM ON THE COURSE OF RADIATION REACTIONS DUE TO THE APPLICATION OF SOFT X-RAYS. Bachurzewski, J.; Pawlowski, A.; Wasylyszyn, J. (Dept. of Dermatology, Warsaw). Pol. Med. J.; 932-6(1969).

To evaluate the effect of the nervous system on the course of

erythema radiation reactions, symmetric sites on the forearms of subjects with unilateral paralysis or after unilateral sympathectomy were irradiated. In one woman the erythema radiation reaction in the paralyzed extremity occurred with a two-week delay, but the further course of the reaction was the same as in the healthy extremity. In rabbit ears deprived of the spinal and autonomic nerve supply the reaction usually occurred earlier and was more intense. On the other hand, on denervated ears late complications in the form of perforation of the ear concha were not observed. It is suggested that the different course of the reaction is due to the better blood supply to the denervated ear. (auth)

32257 EXPERIENCES WITH TELECOBALT IRRADIATION IN LYMPHOGRANULOMATOSIS. Gyoergy, Gyenes (Orszagos Onkologiai Intezet, Budapest). Radiol. Aust.; 18: 189-96(1968). (In German).

Localized and general reactions of patients to supervoltage (^{60}Co) irradiation for lymphogranulomatosis were reported. Because the linear energy transfer and biological effectivity of supervoltage therapy have been reported to be less than with conventional x rays, a 25 to 30% greater dose was required. When ^{60}Co γ irradiation doses of ~3000 R were given to patients, most of the dose was absorbed at a distance of 4 to 5 mm beneath the skin. Localized severe reactions of the skin to fractionated ^{60}Co irradiation, after irradiation of open fields and with sieve irradiation, were not observed. However, several hr after massive doses of ^{60}Co sieve irradiation a transient erythema developed. After ~2 weeks this disappeared and the area became pigmented. No exudative skin reactions were observed. No definite changes in red-cell or leukocyte counts resulted from ^{60}Co irradiation. (BBB)

32258 NON-IONIZING RADIATIONS. Matelsky, I. (General Electric Co., Cleveland). pp 140-78 of Industrial Hygiene Highlights. Vol. I. /Cralley, Lester V. (ed.). Pittsburgh; Industrial Hygiene Foundation of America, Inc. (1968).

The nonionizing radiations (uv rays, visible rays, infrared rays, laser-emitted beams, and radio waves) are discussed in relation to their effects on biological system. The effect of uv rays on skin and permissible limits of exposure are discussed; also, the reactions of visible rays in the eye and photometric terminology, the effects of infrared rays on the skin, laser beam damage to eyes and skin, and the factors affecting the biological effects of radio waves are discussed. The measurement of these nonionizing radiations is then considered. The discussion is concluded with a brief section on control for prevention of undue exposure. 94 references. (C.O.)

32259 EVIDENCE THAT XERODERMA PIGMENTOSUM CELLS DO NOT PERFORM THE FIRST STEP IN THE REPAIR OF ULTRAVIOLET DAMAGE TO THEIR DNA. Setlow, R. B.; Regan, James D.; German, James; Carrier, W. L. (Oak Ridge National Lab., Tenn. New York Blood Center, N. Y.). Proc. Nat. Acad. Sci. U. S.; 64: 1035-41(Dec 1969).

Xeroderma pigmentosum (XP) is a recessively transmitted disorder of man characterized by increased sensitivity to ultraviolet light. Homozygous, affected individuals, upon exposure to sunlight, sustain severe damage to the skin; this damage is characteristically followed by multiple basal and squamous cell carcinomas and not uncommonly by other malignant neoplasia. A tissue culture cell line was derived from the skin of a man with XP. Our measurements of ultraviolet-induced pyrimidine dimers in cellular DNA show that normal diploid human skin fibroblasts excise up to 70 per cent of the dimers in 24 hours, but that fibroblasts derived from the individual with XP excise less than 20 per cent in 48 hours. Alkaline gradient sedimentation experiments show that during the 24 hours after irradiation of normal cells a large number of single-strand breaks appear and then disappear. Such changes are not observed in XP cells. XP cells apparently fail to start the excision process because they lack the required function of an ultraviolet-specific endonuclease. These findings, plus earlier ones on the lack of repair replication in XP cells, raise the possibility that unexcised pyrimidine dimers can be implicated in the oncogenicity of ultraviolet radiation. (auth)

32260 THYROTOXICOSIS: DRUGS, SURGERY, OR RADIOIODINE. Lancet; 2: 944(1 Nov 1969).

The problem of hypothyroidism developing after radioiodine therapy of thyrotoxicosis is considered, especially its detection and treatment. Choice of initial treatment of thyrotoxicosis, by ^{131}I, surgery, or drugs, is also discussed. The incidence of hypothyroidism after radioiodine treatment has been high, and when hypothroidism and recurrence are taken together, unsatisfactory results may also follow thyroidectomy. Whatever treatment is given, the practice of releasing the patient without follow-up arrangements cannot be continued. A follow-up technique using a sensible integration of general-practitioner and hospital resources is mentioned, as well as a system that is developing into an automated follow-up register for thyrotoxic patients. A system devised for the detection of hypothyroidism after radioiodine treatment is also mentioned that is based on periodic measurements of serum protein-bound iodine and analysis of patterns of replies to a postal questionnaire. (BBB)

32261 STUDIES ON STRUCTURAL ANOMALIES IN PATIENTS WITH CONGENITAL MENTAL DEFICIENCY. Arima, M. (Toho Univ., Japan); Komiya, K.; Suzuki, K.; Ono, K.; Iijima, M. Shinkei Kenkyu No Shimpo; 12: 973-85(Dec 1968). (In Japanese).

Congenital anomalies of structure evolve mainly during the process of embryonic differentiation. The association of several anomalies with mental deficiency would indicate that the mental defect might have occurred during the process of organogenesis. This study was performed to determine the frequency and types of associated anomalies in patients with mental deficiency of unknown etiology, and the results were compared with those in patients with chromosome aberrations and other conditions. Amongst the groups, the highest incidence of anomalies was observed in chromosome aberrations, and irradiation embryopathy and mental deficiency with or without cerebral palsy or epilepsy followed it. Pigment anomalies of the skin were most characteristic for irradiation embryopathy. Epilepsy with normal intelligence or hereditary metabolic diseases of the nervous system did not show a difference in the frequency of anomalies from that of normal controls. (auth)

32262 PRESERVATION OF OVARIAN FUNCTION IN PELVIC RADIATION FOR HODGKIN'S DISEASE. Trueblood, H. Ward; Enright, Lee P.; Ray, Gordon R.; Kaplan, Henry S.; Nelsen, Thomas Thomas S. (Stanford Univ., Calif.). Arch. Surg.; 100: 236-7(Mar 1970).

A new procedure is described which is carried out during laparotomy in young women who will likely receive iliac node radiation in the treatment of Hodgkin's disease. The ovaries are moved from their normal lateral position and sutured in a low position to the surface of the uterus in the midline, permitting shielding during treatment of iliac lymph nodes. Fifty-two percent have had preservation of normal periods following radiotherapy. (auth)

32263 ON A CASE OF PROBABLY RADIATION-INDUCED LEUKEMIA. Oftedal, Per. Tidsskr. Norske Laegforen.; 89: 732-5(15 May 1969). (In Norwegian).

The assumed rate of radioinduced leukemia is 20 cases per one million rem, i.e., 100 rem to each of 10,000 individuals. Thus a person exposed to 500 rem has only a 1:20 chance to get leukemia. A court case involving a worker and his employer is reviewed. The worker who operated an industrial x-ray machine for the quality control of weldments, was exposed to radiation between 5 and 50 rem. Seven years later, he was diagnosed as having leukemia, whereupon he claimed that the leukemia was probably induced by his previous exposure. On the basis of the comparison between the spontaneous rate and radiation-induced rate of leukemia, it was concluded that there was a 73% probability that the leukemia was indeed induced by the dose to which he was exposed; the probability of natural occurrence was thus estimated at 27%. (TTT)

32264 KHRONICHESKAYA LUCHEVAYA BOLEZN'. (Chronic Radiation Disease). Kireev, P. M. Moscow; Izdatel'stvo Meditsina (1968). 68p.

A brief review is given of the clinical picture and stages of radiation sickness induced by chronic exposure. Radiation injuries induced by incorporated radioactive substances, the clinical peculiarities depending on the properties of various types of radioactive elements and the means of induction and uptake by various organs are discussed. Diagnosis and therapy of chronic radiosickness are briefly discussed. (R.V.J.)

Radiation Effects on Plants

Refer also to abstracts 31342, 31343, 31838, 31862, 31903, 31912–31917, 31921, 31922, 31927–31932, 31940, 31943, 31945, 31949, 31951, 31953, 31954, and 32004.

32265 PHYSIOLOGICALLY NORMAL SENESCENCE IN SEEDLINGS GROWN WITHOUT CELL DIVISION AFTER MASSIVE γ-IRRADIATION OF SEEDS. Foard, Donald E.; Haber, Alan H. (Oak Ridge National Lab., Tenn.). Radiat. Res.; 42: 372-80(May 1970).

Senescence was studied in wheat seedlings that grow without cell divisions after gamma irradiation of dry grains and in unirradiated control plants. The slow chlorophyll loss in the gamma-plantlet leaf resembled that in the unirradiated control with respect to time-course and chemical regulation. In both gamma-plantlet and normal roots, protoplasmic streaming occurred in all

growing root hairs, and synthesis of insoluble RNA was detected in all cells before they stopped growing. In root hairs of both gamma-plantlets and unirradiated controls, protoplasmic streaming stopped within a day after cessation of their growth. In a given region of roots, detectable synthesis of insoluble RNA stopped within a day of cessation of growth in that region, except that in gamma-plantlets this RNA synthesis persisted for up to 2½ weeks in an extreme apical portion. The lack of gross acceleration of senescence in gamma-plantlets indicated that the doses of 0.5 Mrad or more given to dry wheat grains were not lethal in the physiological sense despite their lethality in the genetic and proliferative senses. (auth)

32266 SENSITIVITY TO GAMMA IRRADIATION OF FUNGI PATHOGENIC TO PEARS. Barkai-Golan, Rivka (Volcani Inst. of Agricultural Research, Bet Dagar, Israel); Ben-Arie, Ruth; Reich, Sylvia Guelfat; Kahan, R. S. Int. J. Appl. Radiat. Isotop., 20: 577-83(Aug. 1969).

The effect of γ irradiation at doses of 50 to 300 krad on the germination ability of fungi in vitro, and on prolongation of the incubation period in vivo, was studied with known spore populations of four fungi pathogenic to stored pears. Rot development and fungal control were examined in cold storage after irradiation of fruit inoculated with two radiosensitive fungi. Inhibition of spore germination was found to be directly correlated to the strength of the radiation dose and indirectly correlated to the spore concentration. Penicillium expansum was the most sensitive to radiation both in culture and in fruit tissues. Some prolongation of the incubation period of P. expansum and of Botrytis cinerea, the two principal pathogens, occurred after irradiation with 100 krad. With increasing dosage the incubation period was more prolonged and staggered, and the percentage of infected fruit began to decrease from 200 krad. Alternaria tenuis and Stemphylium botryosum were radiation-resistant. In spite of a decrease in germination ability at the higher doses, the pathogenicity and incubation period of both these fungi were not significantly affected. (auth) (UK)

32267 PRE-DETERMINATION OF SURVIVAL RATE OF APPLE AND PEAR SCIONS AFTER X-RAY TREATMENT. Visser, T.; De Vries, D. P.; Verhaegh, J. J. (Inst. for Horticultural Plant Breeding, Wageningen, Netherlands). Euphytica; 18: 352-4(1969).

A simple method is described that makes it possible to predetermine the survival rate of dormant scions of woody crops such as apple and pear after x-ray treatment. During early spring irradiated scions were kept on water in a warm glasshouse and the buds were left to sprout. It appeared that the relation between x-ray dose and percentage of buds surviving on the scions after 3 to 4 weeks was similar to the relation between dose and the percentage of irradiated grafts surviving after two growing seasons in the field. Insofar as the dose at which 50% survival occurs is presumed to be the most efficient one, the method enables speedy determination of the most effective dose of x-ray treatment. (auth)

32268 EFFECT OF ^{60}Co GAMMA-RAYS ON THE SEEDS AND PLANTS OF FIBRE FLAX. Sharov, I. Ya. (All-Union Scientific Research Inst. of Horticulture, Moscow). Sel'skokhoz. Biol.; 3: 853-8(1968). (In Russian).

Flax possesses high resistance to ^{60}Co γ-rays. It has been found that lethal doses for flax amount to 180,000 to 200,000 R. Radiation stimulates the development of mutants with some valuable properties. There are families with high resistance to lodging. (auth)

32269 γ-RADIATION EFFECTS ON COTTON SEEDS AND RADIOPROTECTIVE EFFECTS OF SUCCINIC ACID. Egamberdiev, A. M. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 4, 75(1969). (In Russian).

Radioprotective properties of succinic acid were studied using cotton seeds of 1622 type soaked in 0.15% succinic acid 24 hr before exposure to 10 and 20 kR of γ radiation. Data obtained revealed that succinic acid in soaked seeds inhibited γ-ray effects and increased the growth and survival of cotton plants. (R.V.J.)

32270 RADIATION FORMATIONS IN IRRADIATED POTATO TUBERS AND THEIR EFFECTS ON PLANT GROWTH. Kasymov, A. (Tashkent State Univ.). Uzb. Biol. Zh.; No. 5, 7-10(1969). (In Russian).

Increase in concentrations of phenols and quinones (radiotoxins) in irradiated potato tubers was found. While investigating biological qualities, radiotoxins isolated from irradiated potato tubers were found to inhibit seedling development. In test models the effect of intermediates of enzymatic oxidation of tyrosine on seedling development was studied. The action of intermediates of oxidated tyrosine on plant development is similar to radiotoxin actions. (auth)

32271 THE EFFECT OF ASCORBIC ACID ON MELANOGENESIS OF NADSONIELLA NIGRA AND ITS STABILITY TO UV AND γ-RADIATION EXPOSURE. Ruban, E. L.; Lyakh, S. P. (Inst. of Microbiology, Moscow). Izv. Akad. Nauk SSSR, Ser. Biol.; No. 3, 401-5(May-Jun 1969). (In Russian).

It was shown that the introduction of ascorbic acid (at a concentration of 10^{-2} M and higher) into a nutrient medium facilitates the development of a normal, unstained culture of Antarctic black yeast Nadsoniella nigra (strain 365). Inhibition failed to affect the activity of the melanogenous enzyme and the enzymatic stages of pigmentogenesis. The formation of melanin was discontinued at some intermediate stage, most probably at the cost of quinone restoration. On the removal of ascorbic acid the synthesis of melanin terminates nonenzymatically, presumably through oxidative polymerization of quinones. There is a possibility that leukoform pigments regarded as a complex polymer in a state of restoration may be precipitated in the cells of ascorbic cultures. The study of apigment cultures by applying the ESR method has revealed the presence of a small amount of stable free radicals in these cultures. It was established that the latter proved to be several times more resistant to the lethal action of uv and γ radiation exposure than the initial black form of N. nigra. The possible mechanisms of this effect are discussed. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 31771, 31844, 31857, 31859, 31903, 31905, 31906, 31908, 31918, 31923, 31933–31938, 31953, and 32336.

32272 (TID-25355) PLANETARY QUARANTINE PROGRAM. Fifteenth Quarterly Report of Progress for Period Ending December 31, 1969. (Sandia Labs., Albuquerque, N. Mex.). Dec 1969. Contract W-12,853. 48p. Dep. CFSTI.

Effects of pressure, heat, and ionizing radiation on spore viability were studied with respect to spacecraft sterilization. It was found that heat and ionizing radiation inactivate bacteria in a synergistic manner. A mathematical model, based upon the kinetic model for thermal inactivation and the thermoradiation experimental data, was developed. It represented the experimental data taken between 23° and 135° and O Krad/hr to 64 Krad/hr. This model was interpretable in terms of free radical reactions and the previous kinetic model for thermal inactivation. (H.B.G.)

32273 GIANT CELL FORMATION AND VIRUS-SPECIFIC ANTIGENS IN HUMAN HERPES VIRUS: EFFECT OF INFORMATION FROM THE PARENT DNA. Falke, D.; Bitter-Suermann, D.; Clauss, I. (Univ., Mainz). Arch. Gesam. Virusforsch., 27: 317-31(June 1969). (In German).

The effects of uv irradiation on some activities of herpes virus, and the influence of cytosine arabinoside, hydroxyurea, and Mitomycin C on the appearance of herpes-specific membrane-bound or extractable antigens, upon giant cell formation, and the virus-induced inhibition of cell-RNA synthesis were studied. These 3 substances inhibited the synthesis of viral DNA. Under these conditions giant cell formation, antigen synthesis, and inhibition of cellular RNA synthesis were normal (8 hr postinfection). Therefore, the DNA of the infecting virus particle is responsible for these virus-induced functions. Irradiation with uv light was carried out with a Sylvania lamp with peak emission at 2540 Å. The uv irradiation of the infecting virus particles destroyed their capacity to form plaques much more readily than their ability to form multinucleated cells or ability to induce viral DNA synthesis. The ability to induce giant cell formation or virus DNA synthesis apparently requires fewer cistrons than the capacity to form plaques. (BBB)

32274 RESTORATION OF CATALASE: NEW CONCEPTS OF THE PROBLEM. Caldas, L. R.; Alcantara Gomes, R.; Elias, C. A. (Univ. Federal do Rio de Janeiro). An. Acad. Brasil. Cienc., 39: Suppl., 163-73(Dec. 31, 1967). (In Spanish).

From Symposium on Peaceful Uses of Atomic Radiation, Rio de Janeiro, Brazil. See CONF-670709.

Catalase restoration of uv-irradiated bacteria and phage-infected bacteria were observed when the cells were plated in synthetic media in the presence of the enzyme. It has been postulated that uv radiation would promote the formation of peroxides within the cells whose effects were counteracted by catalase. Actually catalase did not reverse uv-radioinduced damage. The enzyme protected cells against the lethal effect of a substance or substances formed during steam sterilization of agar with phosphate in alkaline pH's. If alkaline phosphate is sterilized separately from agar, the toxic substances are not produced and no catalase effect is detected. Ultraviolet light sensitized the cells to the effect of these substances. (auth)

32275 THE EFFECT OF UV LIGHT AND MITOMYCIN C ON THE TRANSFECTION OF BACILLUS SUBTILIS 168 I$^-$. Rytir, V.;

Malek, I. (Inst. of Microbiology, Prague). Folia Microbiol. (Prague); 14: 190-3(1969).

The increased transfection in B. subtilis 160 I⁻ infected with phage DNA isolated from the phage SP 50 after uv irradiation of recipient cells and treatment with mitomycin C is described. A Phillips 1 × TUV lamp served as a source of uv radiation. The number of plaqueforming units increased with increasing uv dose up to 10 sec of treatment, i.e., up to 470 erg/mm² sec. Further increase of the dose resulted in decreased transfection, although a 25-sec treatment (1175 erg/mm² sec) still yielded higher values than the control. The inactivation curve of the recipient cells was also determined, and relatively rapid inactivation was found to occur upon exposure to uv light. Survival of cells after 10- and 25-sec treatment was 12.5% and 0.5%, respectively. Similarly increased transfection was found after treating competent recipient cells with mitomycin C. A maximum increase of transfection was reached with a final concentration of 0.4 μg mitomycin C/l ml of cell suspension, whereas a concentration of 1 μg/ml gave results identical with the control. Survival of the recipient cells was 25% and 2.8% when using concentrations of 0.4 and 1 μg/l ml, respectively. (BBB)

32276 LIMITED GENETIC AND FUNCTIONAL PARTICIPATION IN MULTIPLE INFECTIONS BY UV-IRRADIATED WILD-TYPE T4 PHAGES IN COMPETITION WITH ONE UNIRRADIATED HELPER PHAGE. Barricelli, Nils Aall (Univ. of Oslo, Blinderen, Norway). Genetics; 63: 539-46(Nov 1969).

The basic results, with respect to irradiated phages in competition with an unirradiated helper, are: that there is a limited genetic participation for most irradiated phages lower than for unirradiated phages; that in the high GL functions investigated, there is a limited functional participation for the irradiated phages lower than the limited functional participation found by other investigators. The same low limit of functional participation by uv-irradiated phages is found in macrotarget functions as well, when the cause of their stronger response to irradiated phage multiplicity is accounted for. An irradiated phage participating in (or excluded from) one function is not necessarily participating in (or excluded from) all the other functions. The associated strand providing the early mRNA required for the expression of a macrotarget function, and the genetic strand whose copies provide the later mRNA for the same function do not have to be supplied by the same phage. (auth)

32277 KINETICS OF SUICIDE OF BACTERIAL POPULATIONS. Koch, A. L. (Univ. of Florida, Gainesville). pp 133-45 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

Based on a number of assumptions, formulas are presented for the survival of hypothetical bacterial cultures under self-irradiation by incorporated tritium in the chromosomal material. The formulas average over different classes of cells in the balanced growing populations taking into account the increased rate of inactivation of cells with more DNA, and that nuclear division causes the number of independent chromosomes to increase. The partial multinuclearity tends to make the logarithmic survival curves concave downward, but heterogeneity in amount of DNA in the chromosomes does the opposite. Details of how the resultant effects compensate for various patterns of DNA replication and how the target numbers and final slope are given. If DNA synthesis takes only a small fraction of the total cycle, the survival curves are the well-known one or two target curves and intermediate forms depending on the point in the cell cycle that the synthesis takes place. If synthesis takes almost all of the cell cycle as is the case for enteric bacteria growing in glucose minimal medium, the apparent target numbers are lower and are, in fact, unity if nuclear division is midway in the cell cycle. This is consistent with the experimental results in studies of survival, and in cytological and other studies of the nuclear replication cycle. The effect of gaps in DNA synthesis at various parts of the cell cycle are given and their relevance to various biological systems is discussed. The apparent target number is lowest if synthesis takes place at the end of the cell cycle than if it takes place earlier. Means are provided so that the sensitivity of the resting genome can be calculated from the results of measurements of balanced growing populations. (auth)

32278 LETHAL EFFECT ON BACTERIUM OF DECAY OF INCORPORATED RADIOACTIVE ATOMS (^{3}H, ^{14}C, ^{32}P). Apelgot, Sonia (Institut du Radium, Paris). pp 147-63 of Biological Effects of Transmutation and Decay of Incorporated Radioisotopes. Vienna; International Atomic Energy Agency (1968). (In French).

From Meeting on Biological Effects of Transmutation and Decay of Incorporated Isotopes, Vienna, Austria. See STI/PUB-183; CONF-671036.

The biological effect of decay of ^{3}H, ^{14}C, and ^{32}P incorporated into a bacterium depends on the nature of the organic molecule labeled, on the position of the isotope within it and on the isotope itself. In sum, results obtained to date show that: The decay of ^{3}H atoms incorporated into certain macromolecules of a bacterium causes sterilization through ionization by the β^- particle emitted; transmutation is of negligible importance. This self-irradiation is comparable in effect with X rays and is affected in a similar manner by the same factors: temperature, presence of a radioprotector, radiosensitivity of the strain. Decay of ^{14}C or ^{32}P atoms incorporated into bacterial DNA is lethal because of the transmutation effect; ionizations produced by emitted β^- particles may be disregarded. Survival curves for ^{32}P transmutations depend on the experimental conditions. Some of the results obtained with ^{32}P are similar to those obtained with X rays, e.g., effects of temperature, radical capture and oxygen, while others are similar to those of uv light, e.g., effect of growth conditions. Comparative tests made with ^{32}P indicate that the recoil energy of transmutation is not the phenomenon responsible for the lethal effect observed. Comparison of the results obtained after X irradiation or decay of ^{3}H or ^{32}P incorporated into the DNA of bacteria of the same strain of Escherichia coli shows that the efficiency of a ^{32}P transmutation is about four times greater than that of an ionization produced at random within the same DNA. (auth)

32279 MUTANTS OF SALMONELLA TYPHIMURIUM LT2 SENSITIVE TO ULTRAVIOLET AND TEMPERATURE. Pokrovskii, V. N.; Zlatev, V. I.; Andreeva, I. V.; Skavronskaya, A. G. (Inst. for Epidemiology and Microbiology, Moscow). Mutat. Res.; 8: 659-62(Nov-Dec 1969).

Ultraviolet-radiosensitive mutants of Salmonella typhimurium LT2 are described. Some properties, such as ultraviolet-survival curves, sensitivity to γ rays and some chemical agents, filament formation, and shift-down recovery on minimal medium, are similar to Lon mutants. At the same time, the mutants possess some properties different from those of Lon mutants. It is suggested that the recovery due to minimal medium and pantoyl lactone may represent different mechanisms. Thermosensitivity puts the mutants in a special class. Selection of strain P20t⁺, which is uv radiosensitive and has other properties typical of Lon mutants but does not show thermosensitivity, suggested that the Salmonella mutants studied contain two mutations, probably in different genes. The fact that three similar mutants were obtained independently under the influence of different mutagenic agents suggested that both the uv-sensitivity and thermo-sensitivity are due to one type of mutation. (C.O.)

32280 INFLUENCE OF GLUCOSE ON THE REPAIR OF SINGLE-STRAND BREAKS IN DNA OF X-IRRADIATED ESCHERICHIA COLI B/r. Wilkins, R. J. (Univ. of Otago Medical School, Dunedin, N. Z.). Int. J. Radiat. Biol.; 17: 293-6(1970).

The change in the sedimentation profile of denatured DNA after irradiation with 14k rads showed that a considerable number of single-strand breaks were induced in the DNA of E. coli B/r by the x rays. In bacteria incubated in tris-HCl buffer without glucose immediately after irradiation, a significant number of these breaks had rejoined after 40 min. When glucose, at a final concentration of 1% was added to the tris-HCl buffer during post-irradiation incubation, no rejoining of breaks was found at 40 mins. There was no significant difference in the survival of bacteria incubated with or without glucose. Complementary experiments showed that incorporation of ^{3}H-TdR into the DNA of the bacteria was greater in both non-irradiated and irradiated bacteria if glucose were added to the buffer, suggesting that the inhibition of DNA synthesis by glucose is unlikely. (UK)

32281 STIMULATION OF THE PROCESSES OF SOMATIC EMBRYOGENESIS IN SOME PORIFERA AND COELENTERATA. III. EFFECT OF IRRADIATION ON THE FORMATIVE PROCESSES IN SPONGES AND COELENTERATA. Korotkova, G. P.; Tokin, B. P. (Leningrad State Univ.). Acta Biol. Acad. Sci. Hung.; 20: 141-52(1969).

The effects of β irradiation ($^{90}Sr + ^{90}Y$) were studied in the sponges Leucosolenia complicata and L. variabilis and in the hydroids Clara multicornis, Laomedea flexuosa, and Coryne loveni. L. complicata and L. variabilis were found to be very resistant of β irradiation. Doses of 25, 50, and 100 KR were not lethal within 15 to 17 days. Doses of 450 KR did not kill Laomedea flexuosa and Coryne loveni. β Irradiation (2 to 25 KR), inducing a disintegration of cell systems, could induce somatic embryogenesis and stimulated the initial processes of hydrant formation in Laomedea flexuosa. The increase of radiosensitivity was correlated with the increase of the organization complexity of the organism. The results of the irradiation of some Planaria and

Actinia are considered, and results of the experiments are discussed on the basis of the authors' theory of regeneration and somatic embryogenesis. (M.M.B.)

32282 INITIAL SITE OF SYNTHESIS OF VIRUS DURING RESCUE OF SIMIAN VIRUS 40 FROM HETEROKARYONS OF SIMIAN VIRUS 40-TRANSFORMED AND SUSCEPTIBLE CELLS. Wever, Grace H.; Kit, Saul; Dubbs, D. R. (Baylor Coll., Houston). J. Virol.; 5: 578-85(May 1970).

Simian virus 40 (SV40) can be rescued from certain SV40-transformed hamster cells by fusion with susceptible African green monkey kidney (CV-1) cells, in the presence of ultraviolet-irradiated Sendai virus. We have determined the sites in which SV40 is produced during rescue in these heterokaryons. To determine the sequence, nuclei were isolated from fused cells at various times after fusion, separated on sucrose-density gradients, and assayed for infectious center formation and virus content on CV-1 monolayers. Virus was first detected in the transformed nucleus (40 hr postfusion), and later associated with both transformed and susceptible nuclei (68 to 72 hr). Viral rescue apparently does not depend upon the transfer of SV40 deoxyribonucleic acid to a susceptible CV-1 nucleus, since the transformed nucleus is the primary site of virus production. The time course of certain cytological events in the rescue process and in productive infection was found to be similar. (auth)

32283 TECHNIQUES OF RADIOSENSITIZATION. Bacq, Z. M. (Univ., Liege). Rev. Med. Liege; 23: Suppl. No. 1, 151-5(Oct 1968). (In French).

Mechanisms of action that could be important in the increase of cellular sensitivity to irradiation were discussed. The methods described included increasing the partial pressure of O_2 in anoxic cells in order to accelerate their reactions, combining irradiation with administration of an alkylating agent such as nitrogen mustard or epoxide, or inhibiting the repair of DNA. Results from clinical use of O_2 have varied considerably in their efficacy. The alkylating agents induce changes in the DNA structure of cells, where the alkylating agent largely becomes attached to the guanine residues, bridging 2 guanines. Studies of effects of uv irradiation and alkylating agents on bacterial cells and the postirradiation DNA repair process at the molecular level were described. The pathway included the initial radiochemical modification of a nucleotide with resulting local distortion of H bonding, opening of phosphate ester bond by a hypothetical endonuclease, exonucleolytic excision of 5'-nucleotides by an exonuclease, where only the 3'P or 3'OH terminated strand is attacked, polymerase-mediated DNA synthesis starting at 3'OH ends, and closing of final 3'OH–5'P link by a ligase. Radiosensitization was reported in 2 cases. In one case where the RNA incorporated 5-fluorouracil, the DNA was no longer reparable by the enzyme system and became sensitized to irradiation. Mitosis was affected most since the 5-fluorouracil was incorporated into the DNA during synthesis just before mitosis. Resting cells did not incorporate the fluorouracil and were not radiosensitized. In a second case, one or more enzymes became inactive because either they were unable to act on the proper molecule or lacked a coenzyme that reacted with sulfhydryl groups. Their function was blocked by addition of iodoacetate, iodoacetamide, N-ethylmaleimide, or some Hg compounds. Thus, radiosensitization was related to the DNA repair system in the normal cell. (BBB)

Radiosterilization and Radiopreservation

Refer also to abstracts 31364, 31569, 31913, 32170, 32172, and 32266.

32284 (COO-1689-5) RADIATION PASTEURIZATION OF FRESH MEATS AND POULTRY. Annual Report, February 15, 1968–February 14, 1969. Urbain, Walter M.; Giddings, George G.; Belo, Panfilo S.; Ballantyne, William W. (Michigan State Univ., East Lansing. Dept. of Food Science). 15 Mar 1969. Contract AT(11-1)-1689. 88p. Dep. CFSTI.

A program to develop the process of radiation pasteurization of fresh meats and poultry to permit centralized cutting of these products is discussed. Results are reported from studies on the effectiveness of the integrated approach in solving the discoloration, drip, and microbial problems. Irradiation of fresh beef at 50 to 150 Krad γ or electrons in combination with conventional refrigeration (35 to 42°F) delayed the onset of microbial spoilage. Treatment with condensed phosphates (e.g., tripolyphosphate) controlled fluid exudation and aided in preventing pigment oxidation. Bulk vacuum packing of the individual cuts at the point of cutting, and re-exposure of the cuts to the atmosphere at the point of retail sale resulted in normal red meat color in the display case. This combination approach worked satisfactorily in the laboratory and shows considerable promise. Developmental efforts, particularly in the areas of phosphate application and packaging, are continuing. (C.H.)

32285 (STI/DOC-10/104) MICROBIOLOGICAL SPECIFICATIONS AND TESTING METHODS FOR IRRADIATED FOOD. Report of a Panel of Experts Organized by the FOA and IAEA in Collaboration with IAMS. Technical Reports Series No. 104. (International Atomic Energy Agency, Vienna (Austria)). Apr 1970. 121p. IAEA $4.00.

Special problems related to microbiological specifications are radappertization, or the application to foods of doses of ionizing radiation sufficient to reduce the number and activity of viable organisms to such an extent that very few are detectable in the treated food; radicidation, or the application to foods of doses of ionizing radiation sufficient to reduce the number of viable specific non-spore-forming pathogenic microorganisms; radurization, or the application to foods of doses of ionizing radiation sufficient to enhance keeping quality by causing substantial reduction in the numbers of viable specific spoilage microorganisms. Principles of legislative control and recommendations following general specifications are discussed. Other aspects of microbiological specifications discussed are quality of foods to be irradiated, packaging of irradiated foods, labeling of irradiated foods, storage life, shelf life, and specifications for food receiving particular types of radiation treatment. Methods for determination of specific microorganisms in irradiated foods include enumeration and isolation of fungi from foods, and enumeration of mesophilic aerobes and anaerobes. Methods of determining food-born mycotoxins are described. Formulas are given for culture media and reagents used. (H.L.W.)

32286 (STI/PUB-166) ISOTOPES AND RADIATION IN ENTOMOLOGY. Proceedings Series. Proceedings of a Symposium held in Vienna, 4–8 December 1967. (International Atomic Energy Agency, Vienna (Austria)). 1968. 440p. (In several languages). (CONF-671209). IAEA $9.00.

Separate abstracts were prepared for 30 papers presented at the conference. An abstract of an additional paper appeared in a previous issue of NSA. (H.L.W.)

For abstracts of individual papers see: 31792–31794, 31827, 31828, 31898, 31899, 32163–32175, and 32318–32327.

32287 (STI/PUB-185) RADIATION, RADIOISOTOPES, AND REARING METHODS IN THE CONTROL OF INSECT PESTS. Panel Proceedings Series. Proceedings of a Panel Held in Tel Aviv, Israel, 17–21 October 1966. (International Atomic Energy Agency, Vienna (Austria)). Jun 1968. 153p. (CONF-661070). IAEA $4.00.

Separate abstracts were prepared for five papers presented at the conference. An additional eleven papers were presented on various aspects of insect control. (H.L.W.)

For abstracts of individual papers see: 32328–32332.

32288 (STI/PUB-224) STERILE-MALE TECHNIQUE FOR ERADICATION OR CONTROL OF HARMFUL INSECTS. Panel Proceedings Series. Proceedings of a Panel held in Vienna, 27–31 May 1968. (International Atomic Energy Agency, Vienna (Austria)). 1969. 151p. (CONF-680557). IAEA $4.00. Dep.

Separate abstracts were prepared for 15 papers for inclusion in NSA. One gives an overall summary of the panel. (C.O.)

For abstracts of individual papers see: 32294–32308.

32289 (TID-25404) TWO-YEAR CHRONIC ORAL TOXICITY OF LOW DOSE IRRADIATED PAPAYAS IN BEAGLE DOGS. Status Summary. (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). [1970]. Contract AT(11-1)-2014. 44p. Dep. CFSTI.

Nine months of feeding non-irradiated papayas, and papayas irradiated at 75,000 rads and 200,000 rads γ radiation at a dietary level of 15% to beagle dogs revealed that male animals receiving papayas irradiated at 200,000 rads and female animals receiving non-irradiated papayas and papayas irradiated at 75,000 rads displayed weight gains considerably higher than their respective negative control groups. No other significant differences with respect to body weight were noted. Food consumption and food efficiency for the negative control, positive control, and two test groups were essentially the same. Statistical comparisons of six-month hematologic and blood chemistry data revealed that male animals receiving papayas irradiated at 75,000 rads displayed erythrocyte, hemoglobin, and hematocrit values that were significantly depressed. Males receiving non-irradiated papayas displayed significant elevations in the number of neutrophils present during the 6-month differential leukocyte count. (C.H.)

32290 (TID-25405) TWO-YEAR CHRONIC ORAL TOXICITY OF IRRADIATED PAPAYAS. Status Summary. (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). [1970]. Contract AT(11-1)-2014. 22p. Dep. CFSTI.

The results of nine months of a projected two-year feeding study of irradiated papaya to albino rats revealed no adverse physiological effects. (C.H.)

32291 (TID-25406) TWO-YEAR CHRONIC ORAL TOXICITY OF LOW-DOSE IRRADIATED PAPAYAS SWISS WHITE MICE. Status Report. (Industrial Bio- Test Labs., Inc., Northbrook, ill.). [1970]. Contract AT(11-1)-2014. 22p. Dep. CFSTI.

Results are reported for nine months of a projected two-year feeding study of γ irradiated papayas to Swiss White Mice. No adverse effects were observed on body weights, food consumption, mortality, reactions, hematology, clinical chemistry, and gross and microscopic pathologic studies. (C.H.)

32292 (TID-25407) THREE-GENERATION REPRODUCTION STUDY ON LOW DOSE IRRADIATED PAPAYAS IN SWISS WHITE MICE. Status Report. First Generation. (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). [1970]. Contract AT(11-1)-2014. 19p. Dep. CFSTI.

A two year chronic and reproduction oral toxicity study with albino mice fed γ irradiated papayas as 15% of the total diet is being conducted. Results are reported from studies on the reproductive capacity of the first generation. (C.H.)

32293 (TID-25408) THREE-GENERATION REPRODUCTION STUDY ON LOW DOSE IRRADIATED PAPAYAS IN ALBINO RATS. Status Report. First Generation. (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). 17 Apr 1970. Contract AT(11-1)-2014. 17p. Dep. CFSTI.

No adverse effects were noted with respect to body weight, mortality, mating indices, fertility indices, gestation times, and incidences of pregnancy and parturition among rats fed a diet containing 15% net weight of low-dose γ irradiated papayas. (C.H.)

32294 SUMMARY OF THE PANEL. pp 3-15 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

A list of insects on which research information is available and which are ready for field testing is given. The need for a research development and evaluation fund is discussed and a list of insects on which basic and applied research is needed is given. Brief discussions on ecological considerations, radiation doses, and genetic mechanisms are presented and some specific projects are discussed, including training and education projects. (C.O.)

32295 CONCEPT AND VALUE OF ERADICATION OR CONTINUOUS SUPPRESSION OF INSECT POPULATIONS. Knipling, E. F. (Dept. of Agriculture, Beltsville, Md.). pp 19-32 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

A general review of the sterile-male technique is followed by a discussion of the application of this technique to certain insect species such as the corn earworm, Heliothis Zea (Boddie), the codling moth, Carpocapsa pomonella (Linnaeus), the pink bollworm, Pectinophora gossypiella (Saunders), the gypsy moth, Porthetria dispar (Linnaeus), the sugar-cane borer, Diatraea saccharalis (Fabricius), and others. The potential of F_1 sterility resulting from sub-sterilizing doses of gamma radiation administered to the P generation is discussed. (auth)

32296 BIOLOGICAL INFORMATION NEEDED IN THE STERILE-MALE METHOD OF INSECT CONTROL. Lindquist, A. W. (Dept. of Agriculture, Bridgeport, Kan.). pp 33-7 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

The necessity of accurate data in certain areas of ecology prior to application of the sterile-male technique is discussed. These data include population density, distribution, flight range and mating behavior. (auth)

32297 POTENTIAL OF THE STERILE-MALE TECHNIQUE IN INTEGRATED INSECT CONTROL PROGRAMS. Delucchi, V. (Food and Agriculture Organization of the United Nations, Rome). pp 39-44 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

There are essentially three aspects which have to be considered in integrated control. First of all the approach should not be restricted to a given pest but should include the entire ecosystem, which entails all living organisms in their overall environment. Secondly, control measures should be applied taking into account mortality and suppressive influence of natural factors (biotic and abiotic) which could be exploited to the fullest extent possible. Thirdly, control procedures should have a minimum deleterious impact on the ecosystem. The potential of the sterile-male technique is discussed within these three aspects of integration and consideration is given to its possible side effects on natural control. (auth)

32298 ACTIVITIES OF THE UNITED STATES ATOMIC ENERGY COMMISSION RELATED TO RADIATION TECHNIQUES USED IN CONTROL OF INSECTS. Rabson, R. (Atomic Energy Commission, Washington, D. C.). pp 45-9 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

The activities of the U. S. Atomic Energy Commission (USAEC) in relation to the sterile-male technique for insect control are listed. As an example, the joint efforts of the USAEC with the Instituto Interamericano de Ciencias Agrícolas (ICA), the Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA) and the IAEA are discussed. The co-operative activities with Puerto Rico and Peru are also mentioned. Work supported by the USAEC at different universities in the United States of America is briefly described. (auth)

32299 PROBLEMS IN LARGE-SCALE STERILE-MALE TECHNIQUE PROGRAMS IN DEVELOPING COUNTRIES. Rhode, R. H. pp 51-6 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

Experience acquired in a co-operative project that involves several international organizations plus individual governments has demonstrated that difficulties associated with supply, logistics, communication and personnel are some of the basic problems likely to be encountered by a sterile-insect release program when undertaken in developing regions. (auth)

32300 DEVELOPMENT OF RESEARCH IN STERILIZATION TECHNIQUES FOR AGRICULTURAL INSECT PESTS IN THE USSR. Andreev, S. V.; Martens, B. K.; Molchanova, V. A. (All Union Plant Protection Inst., Leningrad). pp 57-64 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

A list of insects is presented on which the effect of chemo- and radiation sterilization is studied. Some specific data on chemosterilization are given for Carpocapsa pomonella Linnaeus. Results of several experiments using gamma-radiation to sterilize Acanthoscelides obtectus Say are presented. (auth)

32301 STERILE-MALE TECHNIQUE FOR CONTROL OR ERADICATION OF THE BOLL WEEVIL, ANTHONOMUS GRANDIS BOH. Davich, T. B. (Dept. of Agriculture, State College, Miss.). pp 65-72 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

Results of several field experiments to study the sterile-male technique for eradicating the boll weevil, Anthonomus grandis Boh., are reported. The weevils were sterilized by dipping the adults in a solution of apholate. Although eradication was not achieved in any tests, definite population suppression was obtained, indicating that the sterile-male technique is applicable for boll weevil eradication. One experiment utilizing gamma-radiation for sterilization is described. (auth)

32302 SIGNIFICANCE OF THE STERILE-MALE TECHNIQUE IN PEST MANAGEMENT OF THE WHITE GRUB (MELOLONTHA VULGARIS F.). Horber, E. (Swiss Experimental Station for Agriculture, Zurich). pp 73-85 of Sterile-Male Technique for

Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

The known facts on biology and behavior of the cockchafer (Melolontha vulgaris F.) and the conventional control methods are reviewed in relation to the possibility of applying the sterile-male technique to this insect pest. The long development cycle and the aggregation of population in areas which may be delimited and sampled for population estimates facilitates long-term prognosis of the damage to be expected. Actual and potential control methods are critically evaluated in order to integrate pest management with methods not merely reducing numbers but also lowering the reproduction rate. Dynamics of cockchafer populations under favorable and unfavorable conditions are described and the consequences of conventional control and regulation methods are demonstrated. With the aid of simplified hypothetical models long-term effects of the sterile-male technique are compared with those of chemical control. It is concluded that the sterile-male technique would contribute decisively to long-term population regulation. As a unique and efficient method it should therefore be integrated into management of this insect pest, and could be recommended under conditions favorable to the development of cockchafers where rapid resurgence of population after conventional treatments have to be expected as well as under ecologically unfavorable conditions, where conventional methods are not feasible because of topographical difficulties or because of high costs. (auth)

32303 PRESENT STATUS AND POTENTIAL USE OF THE STERILE-MALE TECHNIQUE FOR CONTROL OF RICE STEM BORERS. Hyun, Jai Sun (Seoul National Univ., Suwon, Korea). pp 87-90 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

After discussion of some biological and control aspects of the Asiatic rice stem borer, Chilo suppressalis Walker, radiation experiments are described. Some general conclusions are arrived at for the use of the sterile-male technique on the rice stem borer. (auth)

32304 STERILE-MALE TECHNIQUE STUDIES IN HUNGARY. Jermy, T.; Nagy, B. (Research Inst. for Plant Protection, Budapest). pp 91-5 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

Preliminary experiments were carried out by the Hungarian Research Institute for Plant Protection on various insect-pests. Cockchafer (Melolontha melolontha L.) males were irradiated at different doses of gamma and x rays and were tested in laboratory experiments. Mass releases of sterilized males in 1966 and 1967 to obtain experience in collecting, mass irradiating, shipping, marking and releasing methods as well as to make observations on dispersion, were undertaken. Males and females of the bean weevil (Acanthoscelides obtectus Say), treated with γ radiation, were tested for sterility and the males for competitiveness in the laboratory. (auth)

32305 EXPERIMENTS ON MEDITERRANEAN FRUIT FLY CONTROL WITH THE STERILE-MALE TECHNIQUE. Nadel, D. J. (International Atomic Energy Agency, Vienna); Guerrieri, G. pp 97-105 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

A summary of preliminary experiments to evaluate the control or eradication of the Mediterranean fruit fly, Ceratitis capitata Wied., by the sterile-male technique is discussed. Methods of shipping and releasing sterile medflies as well as a preliminary medfly population suppression experiment are described. The suppression experiment, conducted on the island of Capri, Italy, resulted in data which indicate that the sterile-male technique shows promise for controlling or eradicating the medfly. This research was a co-operative undertaking by Italy, Israel and the IAEA. (auth)

32306 STATUS OF THE STERILE-MALE TECHNIQUE FOR MOSQUITO CONTROL. Rai, K. S. (Univ. of Notre Dame, Ind.). Contract AT(11-1)-38. pp 107-14 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969). (COO-38-613).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

The present status of research to use the sterile-male technique for eradication of mosquitoes is reviewed. Included are descriptions of experiments in which use is made of radiation and chemically induced sterilization. Also genetic incompatibility as a means of eradication is discussed. (auth)

32307 PRESENT STAGE OF RESEARCH INTO THE ERADICATION OF THE MEDITERRANEAN AND SOUTH AMERICAN FRUIT FLIES AND THE COTTON STAINER IN PERU BY THE STERILE-MALE TECHNIQUE. Simon F., J. E. (Agricultural Experimental Station, Lima). pp 115-21 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

Laboratory studies at the Entomology Department of the La Molina Experimental Station in Lima, Peru, were undertaken on the following insect species: Cotton stainer, Dysdercus peruvianus G., the South American fruit fly, Anastrepha fraterculus Wied., and the Mediterranean fruit fly, Ceratitis capitata Wied. Some data on irradiation and field work are also included. (auth)

32308 ON THE POSSIBILITY OF A NEW METHOD FOR THE CONTROL OF INSECT PESTS. Serebrovskii, A. S. (Moscow State Univ.). pp 123-37 of Sterile-Male Technique for Eradication or Control of Harmful Insects. Vienna; International Atomic Energy Agency (1969).

From Panel on Sterile-Male Technique for Eradication or Control of Harmful Insects, Vienna, Austria. See STI/PUB-224; CONF-680557.

The new principle of insect control consists in disturbing the propagation of the pest population by means of translocations. It is well known that individuals heterozygous for some translocations usually form a portion of aneuploid gametes and give a more or less inviable aneuploid progeny. On releasing, therefore, a sufficient number of individuals with a chromosome set altered by translocations into a wild population (with allogamous propagation), there will arise heterozygotes for translocations yielding a certain percentage of inviable offspring. Crosses inside this population will be similar to those between species with resulting sterility of hybrids. The theoretical analysis reveals that if a wild population is mixed in proportion 1:1 with some race containing only one translocation viable in homozygous condition and giving in heterozygotes 50% of aneuploid gametes, the reproduction of the population will be reduced by 43%. If several races with different allelic translocations are released the reduction of reproduction in the population can reach 75%, and if races with 4 to 5 independent translocations are used the reduction can attain 95% to 99% and even more. A population consisting of races with different translocations cannot remain in balance. Those types of chromosomes that happened to be in minority are subjected to elimination. Yet this process of elimination will go on during many generations and thus the disturbance of reproduction will be protracted. By an additional releasing of eliminating race, this disturbance can be maintained permanently. Diverse variants of this method are possible, depending upon the biology and economic importance of injurious insects, the cost of breeding translocated races in laboratories, the difficulties of obtaining viable translocations, etc. It is possible, for instance, to release only males, a method in which there is evidently no danger at all. The present investigation is a purely theoretical one. For the purpose of verifying experimentally this idea work has been started with Musca domestica and Calandra granaria—two insects widely differing in their cytogenetics, ecology and the kind of damage caused. (auth)

32309 STERILIZATION OF GLOSSINA TACHINOIDES WEST. MALES BY GAMMA RAY IRRADIATION. Itard, J. Rev. Elevage Med. Vet. Pays Trop., 21: 479-91(1968). (In French).

The consequence of γ irradiation of adult Glossina tachinoides West. males was studied by the use of the sterile-male release technique for control of this species. The optimal doses of irradiation are between 15,000 and 17,000 rads. With these doses, males are completely sterilized, but their sexual behavior is unchanged and their longevity still satisfactory. These doses are lower than those necessary to obtain complete sterility of Glossina morsitans morsitans Newst. males. (auth)

32310 RECENT DEVELOPMENT AND PROBLEMS IN FOOD IRRADIATION RESEARCH IN JAPAN. Sumiki, Yusuke (Inst. of

Physical and Chemical Research, Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 10-13(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The development of food irradiation programs in Japan is reviewed. The Japan Food Irradiation Research Council was established in 1965 to promote cooperation among dosmestic researchers and industralists and an eight-year plan was initiated in 1967 for the promotion of the radiation processing of selected foods. The items selected included the radiation processing of onions and potatoes for sprout inhibition, sausage, flour, rice, marine paste products, and tangarines for sterilization, and flour and rice for deinfestation of insect pests. (C.H.)

32311 PRESENT STATUS OF FOOD IRRADIATION RESEARCH IN JAPAN. Matsuyama, Akira (Inst. of Physical and Chemical Research, Yamato, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 697-705(1969).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Programs in Japan on the radiation processing of foods during 1966 to 1969 are reviewed. Optimal doses of γ radiation for inhibition of sprouting of stored onions and potatoes were determined to be 7 to 15 krad and 10 to 20 krad, respectively. The effects of low doses of electrons on the maturation of stored fruits and vegetables were studied. The effects of various doses of γ radiation on the storage life and wholesomeness of wiener sausages and sea foods and on the disinfestation of insect pests in stored rice were investigated. Studies on the radiosensitivity of Clostridium botulinum type E in stored fish were carried out. The wholesomeness of γ radiation processed onions and potatoes was tested in feeding tests using mice, rats, and monkeys. (C. H.)

32312 PRESENT STATUS OF FOOD IRRADIATION IN GERMANY. Kuprianoff, J. (Federal Research Centre for Food Preservation, Karlsruhe, Ger.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 711-14(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The sale of foods processed using ionizing radiation is prohibited in the Federal Republic of Germany. Recommendations for criteria for the evaluation of the wholesomeness of radiation processed foods were prepared by the German Research Council in 1968. Research programs in the field of food irradiation are reviewed. (C. H.)

32313 PRESENT STATUS AND FUTURE PROSPECT OF FOOD IRRADIATION DEVELOPMENT IN JAPAN. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 966-84(1969). (In Japanese).
From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Data are summarized from studies on the effects of various doses (7 to 30 Kr) of γ radiation on the storage life and wholesomeness of potatoes, onions, and unpolished rice. Studies on the possible toxicity of γ-irradiated potatoes and onions were conducted using mice, rats, and monkeys. Preliminary results are discussed. (C. H.)

32314 USE OF IONIZING RADIATIONS FOR CONTROL OF AGRICULTURALLY HARMFUL INSECTS. Cavalloro, Raffaele (EURATOM, Ispra, Italy). pp 101-11 of Applicazioni dell'Energia Nucleare in Agricoltura. Roma; Comitato Nazionale Energia Nucleare (1968). (In Italian).
From Applications of Nuclear Energy in Agriculture Conference, Palermo, Italy. See CONF-670558.

Ionizing radiation can be used against agriculturally harmful insects either by induction of sterility or by the direct deinfestation of agricultural products. Examples are given of both applications and their limitations are discussed. (J.S.R.)

32315 CONSERVATION OF NUTRIENTS BY MEANS OF IONIZING RADIATION. Porretta, Antonino (Stazione Sperimentale Industria Conserve Alimentari, Parma, Italy). pp 113-32 of Applicazioni dell'Energia Nucleare in Agricoltura. Roma; Comitato Nazionale Energia Nucleare (1968). (In Italian).
From Applications of Nuclear Energy in Agriculture Conference, Palermo, Italy. See CONF-670558.

The general concepts of food preservation by means of radiation are outlined. The toxicity of the irradiated food products is discussed. The techniques for radiation sterilization are described. (J.S.R.)

32316 SOME FACTS ABOUT THE RADIOSTERILIZATION OF DRUGS. A STUDY. Seidl, R.; Opletal, Z.; Blazek, J.; Cerny, P. (Lab. for Drug Control, Uherske Hradiste, Czech.). Pharmazie; 24: 48-52(Jan 1969). (In German).

Practical possibilities for irradiation sterilization of various types and forms of drugs by ^{60}Co γ irradiation were discussed. These included drugs such as eye drops, chloramphenicol solutions, infusion solutions, anticoagulant solutions, and salves. Effects of irradiation sterilization were measured for airborne contamination with microflora and after experimental contamination with Bacillus subtilis. The compositions and preparation of the drugs studied and methods of bacteriological and chemical control were described. A single irradiation dose of 4 mR produced complete bacteriological sterilization of the drugs tested. The most pronounced destructive effects produced by the irradiation treatment were observed in the drugs with an aqueous base. Some of the most apparent changes observed and tabulated included decreases in pH, alterations in optical rotation, darkening or color changes, formation of peroxides, decomposition of sugars, and oxidation-reduction changes. The irradiation treatments also caused color changes in the glass or plastic containers used for the drugs. The practicability of using ^{60}Co γ irradiation for drug sterilization is discussed. (BBB)

32317 EFFECT OF GAMMA RAYS ON THE MANGOLD FLY. Klimpin, A. Ya. (Inst. of Biology, Riga). Zashch. Rast. (Moscow); 13: No. 1, 20-1(1968). (In Russian).

A method for sterilizing the mangold fly by γ irradiation was developed. During the period 1963 to 1965 about 15,000 flies at various stages of development were subjected to γ irradiation by an IRT-2000 atomic reactor in doses of 500 to 500,000 R at 100 R/sec. Larvae irradiated a day or two before pupation proved particularly sensitive. The percentage of flies in their first flight increased with increase in age of the irradiated pupae. Thus, to sterilize the flies, the pupae must be irradiated shortly before their first flight. The life expectancy of insects irradiated at the end of the pupal stage with 200 to 100,000 R is an average of 11.5 days compared with 30 days for control flies. The absolute sterilizing dose for male flies was at least 8000 R, for females—5000 R. Gamma rays of 7000 R and above caused pathological changes in the process of development of male reproductive cells. The population of the subsequent generation is reduced 40.3 to 85%, in comparison with a control group, as the ratio of sterile to normal flies increases from 1:1 to 10:1. (JPRS)

32318 STERILIZATION OF THE EUROPEAN CORN BORER OSTRINIA NUBILALIS HB. BY GAMMA IRRADIATION. Anwar, M. (Centre de Recherches Agronomiques du Sud-Est, Montfavet, France). pp 139-48 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In French).
From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Pupae and larvae of Ostrinia nubilalis Hb. were irradiated with a cobalt-60 source. The dose rate was about 1040 rad/min. The effects of different doses on the survival of the pupae, the length of life of the adults, sexual behaviour, fecundity and fertility were studied. Larvae at the end of their development exposed to 5, 10, 15, 20, 25 and 30 krad gave respectively 90, 77, 23, 16, 13 and 10% of pupae; the non-pupated larvae often remained alive in their cocoons for four months or more. At 10 krad and above, no adults hatched. At 5 krad, 63% of adults were obtained; the males and females which hatched showed a fertility of only about 12%, their sexual behaviour, fecundity and length of life being reduced. The sensitivity of the pupae decreased with age; 6- and 12-day-old specimens irradiated at 10 krad gave a hatching rate of 42 and 100% respectively. A dose of 20 krad applied to female 12-day-old pupae was sufficient to make the eggs infertile, while a dose of 40 krad was needed to ensure that irradiated males coupled with normal females gave rise to totally sterile batches of eggs. When groups of sterile butterflies (25 males, 25 females or 25 individuals of both sexes) were introduced into a cage containing five normal butterflies of each sex, the number of viable eggs laid was reduced, the maximum reduction being for the proportion 25:25:5:5. It would therefore seem advantageous to release both irradiated males and females together. (auth)

32319 REARING TECHNIQUE, BIOLOGY, AND STERILIZATION OF THE COFFEE LEAF MINER, LEUCOPTERA COFFEELLA GUER. (LEPIDOPTERA: LYONETIIDAE). Katiyar, K. P.; Ferrer, F. (OAS Training and Research Center, Turrialba, Costa Rica). pp 165-75 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).
From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

For two years the authors studied the feasibility of controlling the coffee leaf miner Leucoptera coffeella Guer. by the radiation sterilization technique. During this period a technique for raising large numbers of this insect on potted coffee plants in the laboratory was devised. The optimal range for the development of egg, larval and pupal stages of the coffee leaf miner was between 20 and 30°C. The pupal stage of female insects was slightly shorter than that of the male. The laying of fertile eggs began during the first night following emergence. During an oviposition period of

16 days the average fecundity was 68 eggs. The maximum oviposition by a single female was 131 eggs over the life span while as many as 34 eggs were laid during a single day of oviposition. To investigate the best stage to induce radiation sterilization, pupal and adult insects were irradiated with ^{60}Co gamma rays. Seven-day pupae (close to emergence) showed 88% lethality in males when given 60 krad; the survivors retained some fertility. Adult females recieving 70 krad were 100% sterile while males given 90 krad showed 0.02% fertility. Doses as high as 90 krad given to newly emerged adults did not reduce longevity. Studies are continuing to determine if sterilizing doses impair sexual vigour and mating competitiveness of the treated males. (auth)

32320 THEORETICAL AND PRACTICAL STUDIES ON A POSSIBLE GENETIC METHOD FOR TSETSE FLY CONTROL. Curtis, C. F. (Univ. of Bristol, Eng.); Hill, W. G. pp 233-47 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Chromosome translocations may be useful in pest control because they are a common type of mutation in a variety of organisms and, frequently, the heterozygote is semi-sterile and the homozygote fully fertile. It might be possible to induce such a translocation in a pest species, to breed from a selected ancestral pair of translocation homozygotes a large number of the homozygotes and to release these into a wild population. This would cause the production of heterozygotes in the wild population and hence would reduce the fertility of the population. This reduction would persist for a number of generations. Calculations, based on simplified assumptions, showed that this method of fertility reduction might be more economical than the use of sterilized males. In the present paper a theoretical comparison is made of the translocation and sterilized-male methods for the control of tsetse flies (Glossina sp.). A computer model has been set up which simulates, as far as possible, the known facts about birth, mating and death in a wild tsetse population. The predicted effects of releases of sterilized males and of translocation homozygotes are described and the modifications which would be caused by density-dependent mortality, migration and reduced viability of the translocation genotypes and sterilized males are indicated. It is concluded that to eradicate a well isolated wild population the numbers of translocation homozygotes required might well be considerably less than the number of sterilized males required for the same task. However, immigration into the population would greatly reduce the efficiency of the translocation method. The progress so far in attempting to produce a suitable translocation in Glossina austeni is described. Males have been treated with 5 to 7 krad of gamma radiation and a number of semi-sterile individuals have been selected from among their progeny. The semi-sterility is inherited and, by analogy with the results in other organisms, is presumed to be due to translocation heterozygosity. The methods being used to attempt to derive translocation homozygotes from the semi-sterile lines are described. (auth)

32321 NEW SITE FOR THE ERADICATION OF A WHITE GRUB POPULATION (MELOLONTHA VULGARIS FABR. AND MELOLONTHA HIPPOCASTANI FABR.) BY RELEASE OF IRRADIATED ADULTS. Horber, E. (Swiss Experiment Station for Agriculture, Zurich). pp 259-71 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

The area considered (about 1100 ha) is situated on the Swiss shore of Lake Constance and is infested with two cockchafer species (Melolontha vulgaris Fabr. and M. hippocastani Fabr.). The dynamics of the cockchafer population were followed from 1955 to 1967. Estimates of the cockchafer population were obtained by: soil sampling for adults; soil sampling for white grubs; observation of flight activity and assessing damage on preferred food trees; capture-recapture method with the aid of marked adults in spring 1967. Estimates were made several times with the isotopic dilution technique. Throughout the flight period 1967 the occurrence of adults was observed along the border of the Güttingerwald. Preferred food trees were regularly inspected and changes of preference with season were noted. Crepuscular flight activity of adults was watched at exposed corners of the wood. Changes in the flight direction during the period of observation were related to sex ratios in samples taken the following morning and compared with the developmental stage of the ovaries. Beetles were collected by shaking the host trees at dawn, and weight and volume of the samples were registered. Four therapeutical x-ray units potentially utilizable for irradiating beetles are available within 35 km. The nearest facility, 5 km away, was tested for its daily capacity. (auth)

32322 EXPLORATORY STUDIES ON THE ERADICATION OF THE KOREAN PINE CATERPILLAR DENDROLIMUS SPECTABILIS BUTLER BY MEANS OF RADIATION. Lee, K. B.; Hwang, U. K.; Lee, K. S. (Atomic Energy Research Inst., Seoul). pp 273-86 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Experiments to develop suitable artificial diets to rear the larvae of the Korean pine caterpillar Dendrolimus spectabilis Butler were carried out in connection with studies on eradication by the sterile-male technique. Several nutritient media were tested on larvae of various instar stages, and one was found to be most successful, rearing 2nd instar larvae without loss of body weight. Mortality at 30 days after artificial feeding was less than one-third. This medium consisted of sucrose, L-ascorbic acid, β-sitosterol, yeast hydrolysate, brewer's yeast, Butoben, choline chloride, residue of pine leaves and sodium glutamate. The composition of the pine leaves as well as of the larvae was analysed to obtain information on the nutritional requirement of the larvae. The larval metabolism of carbohydrate, sterol and protein was also studied. The radiosensitivity of the larvae of the 1st through 4th instar stages is dose-dependent and radioresistance increases with instar age. Doses of 100 krad or less did not produce mortality in the 4th instar, and could be used as the sterilizing dose for irradiation of older larvae or pupae. The number of eggs laid by a normal female mated with males irradiated with a dose of between 1.5 and 100 krad during the pupal stage did not change. The hatchability, however, was affected by irradiation of 15 krad or more where complete absence of hatching was observed. With 5 krad or less hatchability was not reduced from normal (55.8%) while 10 krad resulted in partial reduction. The sexual competitiveness of males irradiated with 15 and 25 krad was about one-half of the normal males and the hatchability of the eggs was reduced by about 50% to 37 and 31% respectively. It was concluded that the use of the sterile-male method in the eradication of the pine caterpillar is feasible if the method for mass rearing of the larvae is successful. Work in this connection is in progress. (auth)

32323 LARGE-SCALE BREEDING OF DYSDERCUS PERUVIANUS G. AND ITS STERILIZATION BY GAMMA RAYS. Simon, J. E. (Estacion Experimental Agricola de la Molina, Lima). pp 287-300 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In Spanish).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

A method of large-scale breeding of Dysdercus peruvianus G. (family Pyrrhocoridae) with natural food and giving a hundredfold population increase each month has been developed in the Entomology Laboratories of the Experimental Agricultural Station at La Molina, Lima, Peru. Cages 90 × 60 × 60 cm are used; 2000 adults are placed in each, care being taken that there are not more males than females (two males to each three females are sufficient). The cage floor consists of wire mesh with nine strands per square inch; the roof, made of cloth or mesh with 14–18 strands per square inch, is fitted with a 15-W fluorescent light or a 60-W incandescent light, and the walls are of wood or some other washable material. Inside the cages are placed two containers with levant cotton shoots, and about 500 g of seed are scattered on the floor. Under the mesh is a sloping floor of plexiglas or some other smooth material which allows the eggs to slide down to a collecting channel ending in a tube marked in centimeters (1 cm^3 = 4250 eggs). Similar cages, but with a wooden or brass floor, are used to contain $\frac{1}{2}$ cm^3 of eggs, which are scattered on the floor covered with levant cotton seed. The eggs hatch and the nymphs grow in this cage until they reach the adult stage, when they are taken out in batches of 2000 and transferred to tanks for adults or irradiated. Doses of 1000, 2500, 5000, and 10,000 R were used, and sterility was obtained from 2500 R, at which dose eggs were produced and development occurred to the first nymph stage. At 5000 and 10,000 R the eggs did not develop. At 1000 R development was normal, and in addition the cycle was accelerated and there were more eggs. Irradiated males and females accepted, and were accepted by, normal insects without discrimination. Competence levels of 2, 8, 32 and 128 males were tested. (auth)

32324 RESEARCH INTO THE APPLICATION OF THE STERILE-MALE RELEASE TECHNIQUE TO THE RHINOCEROS BEETLE (COLEOPTERA: SCARABAEIDAE). Hurpin, B. (Institut National de la Recherche Agronomique, Versailles, France). pp 301-15 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968). (In French).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

The control of the Rhinoceros beetle, which causes considerable damage in palm and coconut plantations in the tropical regions of the world, meets with difficulties resulting from the habits of the insects. Chemical and biological control methods have not yet produced economically worthwhile results. It was therefore proposed, under the Joint Project established by the UN Special Fund and the South Pacific Commission for devising a method of controlling the main pest in this group, Oryctes rhinoceros, that the possibility be investigated of using against these coleoptera the technique of releasing males sterilized by radiation. Studies have been made involving the two most important species O. monoceros Ol. and O. rhinoceros L. The first stage was the development of a continuous breeding method, which had not hitherto been possible because of the large-scale slaughter arising from fungus attacks by Metarrhizium anisopliae Metsch. For the larvae the technique used involved first individual rearing, followed by group rearing tests with 100 or so insects in tanks. The average temperature in both cases was close to 30°C and the insects were fed on a mixture of rotten wood and leaf mould mixed with the faeces of domestic animals. The adults, fed on banana slices, are placed in troughs or tanks containing sieved earth. It was thus possible to rear Oryctes in several successive cycles, avoiding the epizoic stage of Metarrhizium, with a multiplication rate from one generation to the next of close on 10. Tests on radiation sterilization procedures taking as variables the gamma-ray dose, the stage of the insect and the physiological state of the imago, showed that O. monoceros adults were sterilized by a single application of 4000 rad, with a slight reduction in their length of life. The same was true of O. rhinoceros, which, however, required a dose greater than 6000 rad to sterilize it. The mating urge and sexual vigour of the irradiated insects are, however, reduced; competitive trials between irradiated and normal males are described and commented on. Apart from the immediate effects of gamma-rays, a possible deferred effect on the progeny of females mated with partially sterilized males was also envisaged. (auth)

32325 EFFECT OF RELEASING STERILE SCIRPOPHAGA NIVELLA F. ON CROP DAMAGE AND INSECT POPULATION DENSITY IN SUGAR CANE PLANTATIONS. Hatmosoewarno, S. (State Sugar Academy, Djokjakarta, Indonesia). pp 317-29 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

Successful use of the sterile-male technique to control insect populations was reported in several countries. Certain characteristics of a candidate insect must be considered before employment of this technique. Since 1965, experiments have been performed at the State Sugar Academy in Jogjakarta, Indonesia, to examine these characteristics in the white top borer (Scirpophaga nivella F.), an important sugar cane pest, and to determine the suitability of the sterile-male method. Several important characteristics were found suitable, i.e., copulation ability did not decrease after radiation, and rearing on an artificial medium is possible for all life cycle stages. Radiation at the pupal stage induced sterility in the adult. Preliminary experiments in a sugar cane plantation were performed to determine the effect of sterile insect release on the attack intensity and population density. The number of released sterile insects approximately equalled that of the natural population. Release was carried out at a time when cane was susceptible to attack in an area which had previously reported 10% annual crop loss due to this insect's activity. Released sterile insects caused a decrease in the attack intensity and the population density. An examination carried out just before harvesting, after release of the insects had been terminated, revealed that the insect population density at the control plots was roughly equal to that at the release plots. This indicated that the release of the sterile insects would be effective in suppressing the increase of the population if it were constantly done. Another fact that supports this opinion is that although the figures shown by the control plots and release plots just before harvesting were almost equal, the damage in the release plots was only to the leaves. Thus, if we considered that the damage caused by this pest on sugar cane 10 months old or older may be ignored, control could be accomplished by releasing sterile insects during the sensitive period of sugar cane growth. If however, this pest is to be completely eradicated, the release of the sterile insects must be done constantly during the growing period of the sugar cane. (auth)

32326 CONTROL OF ADULT PESTS BY THE IRRADIATION-OF-MALE METHOD. von Borstel, R. C. (Oak Ridge National Lab., Tenn.). pp 331-7 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

The Grosch effect (i.e., of radiation interfering with utilization of nutrients in insects) became applicable to pest control when Galun and Warburg discovered that irradiated ticks fed once would seldom if ever feed again. This lifelong sensation of "impletion" does not interfere with sexual competitiveness, but it does render harmless a pest that is a pest during the adult stage of its life cycle. It would seem that the general principle of treating adult pests to limit their feeding capacity could be extended to other pests. When insect pests are living in stored food products, it is a general rule that desirably low levels of radiation can be used to eradicate the pest if sterilizing doses rather than insecticidal doses are used. With the entire population of both males and females being irradiated, the sterilizing dose is often much lower than that which would be desirable when the insects are mass-reared for irradiation and release. Where mass-rearing techniques are not feasible, or where the pestiferousness of adults cannot be overcome by radiation or other treatments, field-irradiation facilities in baited traps can be devised. These have some advantages over similar traps containing chemosterilants. Wherever it can be used, the method of mass-rearing, irradiation, and release is still the most desirable way to control insect pests. (auth)

32327 GENETIC AND CYTOGENETIC BASIS OF RADIATION-INDUCED STERILITY IN THE ADULT MALE CABBAGE LOOPER TRICHOPLUSIA NI. North, D. T.; Holt, G. G. (Dept. of Agriculture, Fargo, N. Dak.). pp 391-403 of Isotopes and Radiation in Entomology. Vienna; International Atomic Energy Agency (1968).

From Symposium on the Uses of Isotopes and Radiation in Entomology, Vienna, Austria. See STI/PUB-166; CONF-671209.

The relationship of egg hatch as a function of radiation dose is of a two-hit nature when irradiated adult males are mated to non-irradiated virgin females. Sterility as a function of dose is usually linear in insects. However, other species of moths respond similarly to irradiation, so it is indicative that the mechanism involved in producing sterility in Lepidoptera is basically different from that in other insects. The significance of the two-hit kinetics is discussed in relation to the chromosome structure and possible mechanisms for the induction of sterility in Lepidoptera. Many workers using Lepidoptera have reported that females mated to irradiated males oviposit substantially fewer eggs than normally. This response has been correlated to a lack of sperm transfer by irradiated males, even though they pass a spermatophore. The phenomenon is dose-dependent. Although Lepidoptera are far more radioresistant than other insect species when measured by the induction of sterility in the male, there appears to be very little difference when longevity is used as the criterion. The radiation dose required to reduce the lifespan of a newly emerged cabbage looper male by 50% was found to be approximately the same as that for the house fly. High doses of radiation have no immediate effect on the mating behaviour of the irradiated male. With a recessive eye-colour mutant as a sperm marker, it was determined in tests utilizing double matings that the second mating is the effective mating. Sperm mixing is not prevalent; rather it appears to be a "sperm flushing" phenomenon in that sperm from the first mating are displaced by sperm from the second mating. Radiation studies with the cabbage loo have demonstrated that the progeny of a cross where the male parent receives a sub-sterilizing dose of gamma radiation are often semi-sterile when mated to non-irradiated individuals. The amount of inherited sterility is directly dependent on the amount of radiation given the original parent. A dose of 10 krad to a P_1 male, for example, only induces 15 to 20% sterility. However, of the surviving progeny as many as 50% will be semi-sterile with 20% being completely sterile when mated to non-irradiated individuals. The cytogenetic implications of this are discussed; namely, the effect of diffuse centromeres, and the induction of reciprocal translocations. Data are presented on induced translocation frequencies by various doses of radiation and the F_2-bred behaviour of these individuals. This approach possibly affords a more effective tool in insect control. (auth)

32328 REARING AND IRRADIATION OF THE TICK, ORNITHODOROS THOLOZANI. Avivi, A.; Galun, R.; Warburg, M. (Israel Inst. for Biological Research, Ness-Ziona). pp 3-6 of Radiation, Radioisotopes, and Rearing Methods in the Control of Insect Pests. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation, Radioisotopes and Rearing Methods in the Control of Insect Pests, Tel Aviv, Israel. See STI/PUB-185; CONF-661070.

Data are presented on the natural and artificial rearing and irradiation of a tick, which is a vector for human relapsing fever. The tick is a candidate for control by the sterile-male release technique. Adult females were sterilized with 2 kR; males with 16 kR. These males were competitive with control males for

at least six months during which time their fertility did not return. (auth)

32329 EXPLORATORY STUDIES ON THE ERADICATION OF THE KOREAN PINE MOTH DENDROLIMUS SPECTABILIS BUTLER BY USING GAMMA IRRADIATION. Lee, K. B.; Hwang, U. K.; Lee, K. S. (Atomic Energy Research Inst., Seoul). pp 79-85 of Radiation, Radioisotopes, and Rearing Methods in the Control of Insect Pests. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation, Radioisotopes and Rearing Methods in the Control of Insect Pests, Tel Aviv, Israel. See STI/PUB-185; CONF-661070.

Irradiation of the pupae of the pine moth with 15,000 R of gamma rays induced a complete arrest of fertility without harm to the reproductive behavior, adult emergence, and longevity. The larvae of the earlier instar stages were much more sensitive to gamma radiation than those of the later instar stages. The mortality is dose dependent. Field cage tests, using normal male and normal female at a 1:1 ratio, showed that the egg hatchability of 54.9%, and at a ratio 2:1, was 47%. In the experimental group with the ratio of irradiated male to normal female at 1:1:1, the egg hatchability was 37.1%. The sterile males do not seem to compete equally in mating with normal females. The nutritionally essential amino acids for pine moths were determined by using the indirect method. The present experiment shows that it is feasible to rear the larvae of the pine moth on artificial diets. (H.L.W.)

32330 APPLICATION OF THE STERILE-MALE TECHNIQUE ON THE ONION-FLY, HYLEMYA ANTIQUA (MEIG.), IN THE NETHERLANDS. PROGRESS REPORT. Ticheler, J.; Noordink, J. Ph. W. (Instituut voor Plantenziektenkundig Onderzoek, Wageningen, Netherlands). pp 111-15 of Radiation, Radioisotopes, and Rearing Methods in the Control of Insect Pests. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation, Radioisotopes and Rearing Methods in the Control of Insect Pests, Tel Aviv, Israel. See STI/PUB-185; CONF-661070.

The onion-fly causes millions of dollars damage each year to onion crops. This fly was controlled by Dieldrin but, since 1962, it has developed resistance to this and related insecticides. This fly serves as a test case for the application of the sterile-male release technique. The topics considered in this paper include, general biology, rearing on artificial diets, sterilization by radiation dispersal, and mating behavior of the onion-fly. (auth)

32331 RECENT RADIATION WORK WITH THE OLIVE FLY AT THE DEMOCRITUS NUCLEAR RESEARCH CENTER, GREECE. Tsitsipis, J. A.; Tzanakakis, M. E. (Democritus Nuclear Research Center, Athens). pp 117-21 of Radiation, Radioisotopes, and Rearing Methods in the Control of Insect Pests. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation, Radioisotopes and Rearing Methods in the Control of Insect Pests, Tel Aviv, Israel. See STI/PUB-185; CONF-661070.

The purpose of the radiation work with the olive fly, Dacus oleae (Gmelin) described here was to establish gamma-ray doses which, when given to pupae, would permanently sterilize both sexes without affecting the mating ability and longevity of the males. The proper radiation dose, reported elsewhere, was substantiated in earlier work by Italian colleagues, according to whom 8000 to 12,000 rad were satisfactory doses. In addition, 6000 rad were also shown to be adequate. During most of 1965 and 1966 only the 8000-rad dose was used. The insects were laboratory-reared on olives at 25 ± 1°C. They were irradiated as advanced pupae, i.e., upon the appearance of certain color characteristics, which were found to be associated with a certain stage of pupal development. (auth)

32332 POTENTIAL FOR CONTROL OF THE SUGAR-CANE BORER THROUGH RADIO-INDUCED STERILITY. Walker, D. W. (Puerto Rico Nuclear Center, Mayaguez). pp 131-40 of Radiation, Radioisotopes, and Rearing Methods in the Control of Insect Pests. Vienna; International Atomic Energy Agency (1968).

From Panel on Radiation, Radioisotopes and Rearing Methods in the Control of Insect Pests, Tel Aviv, Israel. See STI/PUB-185; CONF-661070.

A project was undertaken to determine whether this species could be effectively sterilized by γ irradiation and, if so, what stage in the life cycle is most suitable for producing the maximum sterility effect with minimum somatic damage and minimal behavior change. In addition an attempt was made to develop a suitable method for culturing the insect in the laboratory under artificial conditions, and other biological studies were made that are relevant to a program of eradication by population overflooding with sterile reproductives. (auth)

32333 IRRADIATION OF PREPACKED PLAICE. Debevere, J.; Vyncke, W. Rev. Agr. (Brussels); No. 3, 409-16(3 Mar 1969). (In French).

Plaice (Pleuronectes platessa L) was prepacked in polyethylene sheets and irradiated at 0.1 and 0.3 Mrad. They were then stored at 1°C and analyzed five times in a period of 16 days. A non-irradiated control sample and a prepacked non-irradiated sample were also kept under the same conditions. Results showed that bacterial count, TVB, trimethylamine, volatile acids (TVZ) and electrical resistance were able to give a clear difference between irradiated and non-irradiated fish. VRS and pH on the other hand did not seem to be suitable methods to follow spoilage in irradiated fish. Between 0.1 and 0.3 Mrad, however, no marked difference could be noted. Organoleptic judgment comfirmed these results. Irradiated fish had a longer shelf life of around 3 days. (auth)

32334 EFFECTS OF RADIATION ON STORED FASCIA LATA FOR OPHTHALMIC SURGERY. Townsend, A. L.; Crawford, J. S. (Univ. of Toronto). Can. J. Ophthalmol.; 4: 331-8(Oct 1969).

Prompted by the need to standardize methods of storing human fascia lata for surgical implantation, suitable strips were tested for their tensile strength in relation to their location in an excised sheet of human fascia lata. The in vitro effect of γ radiation on stored strips was also evaluated and found to be negligible. Using the rabbit for a test model the strength and histology of implanted strips of fascial homograft, irradiated and non-irradiated and viable autograft were examined. After three months the irradiated strips had lost considerable strength in comparison with the non-irradiated and the control strips. (auth)

32335 SPROUT INHIBITION OF POTATOES BY IONIZING RADIATION. PART II. RADIATION TREATMENT OF NORIN-1-GO AND THE EFFECT OF IRRADIATION ON THE CRISPS MADE OF IRRADIATED POTATO. Umeda, K.; Kawashima, K. (Food Research Inst., Tokyo). Nippon Shokuhin Kogyo Gakkaishi; 16: 515-19(Nov 1969). (In Japanese).

The potato variant Norin-1-go was tested for sprout inhibition by irradiation. 7 kRad was enough to keep the potato unsprouted for more than eight months after harvest at room temperature. The 5 to 10 mm germed tubers were also suppressed and failed to grow any more by 7 kRad. The organoleptic test of crisps made of irradiated potato showed that the crisps produced from untreated samples were better than those of treated ones. There was not much difference between the crisps of irradiated potatoes. The reducing sugar content was much higher in the potato stored at 5°C than in that stored at room temperature and decreased a little with radiation dose. The crisps made of potato stored at 5°C and the crisps with a higher dose were darker. The color of the oil extracted from crisps was not affected by the treatment applied. (auth)

32336 RADIATION STERILIZATION OF PHARMACEUTICAL AND BIOPRODUCTS. International Symposium, Salford, England, 31st March-1st April, 1969. Salford, Eng.; University of Salford (1969). 31p. (CONF-690336).

Topics discussed at the conference were as follows: chemical changes induced in organic compounds by ionizing radiations; new methods for the study of mechanisms of radioinduced reactions; pulse radiolysis; electron spin resonance; the application of a code of practice to the control of manufacture of sterile disposable plastic items; a review of progress in radiation sterilization; microorganisms and pharmaceutical products; effects of radiation on microorganisms; radiation sterilization of coagulation factors; radiation sterilization of fibrinogen and antihemophilic by gamma rays; and radiation sterilization of pharmaceutical and bioproducts. (H.L.W.)

32337 NEW WAYS OF KEEPING FISH FRESH. Int. At. Energy Agency Bull.; 12: No. 1, 18-20(1970).

A brief discussion is presented of the effects of radiation processing on storage life of seafood. A report from the Icelandic Fisheries Laboratories on the advantages of irradiated cod, lobster, and shrimp is discussed. Economic advantages of radiation processing of fish and shrimp in India are pointed out. Studies in the United States showed that radiation processing could bring many benefits to the food industry. (H.L.W.)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstracts 31673 and 32502.

32338 PHYSICOCHEMICAL MECHANICS OF METALS AND NUCLEAR REACTORS. Smith, F. A. (Argonne National Lab., Ill.). Int. J. Nondestruct. Test.; 1: 237-49(Oct 1969).

Personal views and laboratory observations are presented to promote quicker utilization of discoveries in basic scientific laboratories. The application of more intensive work in the field of physicochemical mechanics of metals should lead, first, to new discoveries in science; then as these discoveries are made public, other people can consider how the new discoveries may be of practical, scientific use. Discussions are included on physicochemical mechanics of metals, and equipment developed and measurements which have been made in this field. It is noted that in general, the nuclear reactor provides the engineering possibility of the generation of heat to temperatures above the present understanding of an adequate container for the heat generation process. In short, how to establish the relationship between properties of a crystalline model and usable amounts of the same materials after manufacture to a processed state in a usable engineering form at a wide range of temperatures must be learned. (auth)

Corrosion and Erosion

Refer also to abstract 31575.

32339 (GEAP-13539-12) SODIUM TECHNOLOGY DEVELOPMENT PROGRAM MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS. Quarterly Progress Report No. 12, December 1969–February 1970. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). Apr 1970. Contract AT(04-3)-189. 22p. Dep. CFSTI.

In the current program, the number of materials studied has been extended to include cladding candidates for oxide fuel (Types 304, 316, and 347 stainless steels (SS), and Incoloy 800). The temperature range of testing has been increased to 1300°F, and temperature profiles, loop geometry, and sodium purity controls have been established to represent environments of large fast reactors in an improved way. Increasing emphasis has been placed on improving sodium impurity monitoring and control. In-line devices are used to obtain rapid and, where possible, continuous indications of impurity changes. These include chromatography for cover gas, replaceable flow-through sodium samplers, electrochemical cells for oxygen activity and diffusion cells for hydrogen concentration in sodium. Provisions are being made for electrochemical cells for carbon. Cold traps for control of sodium purity in test loops have been modified with electromagnetic stirring devices to increase cleanup rate and automatic controls are being added for continuous and unattended operation. Corrosion and deposition investigations to effect improvements of empirical and rational models for the accurate prediction of corrosion and mass transport for design of primary and secondary sodium systems of large plants are reported. Sodium impurities determinations and particulate impurity identification are reported in which improved methods for sampling of sodium systems, impurity monitoring, collection and identification of particulate material, and chemical and structural analysis are investigated. An operating objective is to provide well controlled operation of loops and to support the development of rational models. A program is also described to obtain exposures of specific LMFBR candidate materials, including Types 304 and 316 stainless steel tubing, and to determine correlations between mass transfer and sodium impurity effects which affect long term stress rupture properties. (J.R.D.)

32340 (KFK-991) SODIUM CORROSION EXPERIMENT WITH STEEL FUEL ELEMENT CANS FOR A SODIUM-COOLED FAST BREEDER REACTOR. Borgstedt, H. U.; Frees, G.; Drechsler, G. (Kernforschungszentrum, Karlsruhe (West Germany)). Aug 1969. 19p. (In German). (EUR-4300). Dep. CFSTI (U. S. Sales Only).

Results of corrosion studies on the German high-temperature stable austenitic steels No. 4961, 4981, and 4988 in the sodium loop Cerberus were used to establish annual wall thickness losses at 0.0×10^{-4} cm/yr and at 500°C; 0.10×10^{-4} at 500°C; and 0.15×10^{-4} at 600°C. These values are qualitatively in agreement with literature values. They show that the German steels tested in sodium behave similarly to the U.S. steels AISI 304 and 316. After about 5000 hr in sodium, the effects on contents in interstitial components are not measurable in these steels. (tr-auth)

32341 CORROSION RESISTANT NICKEL-BASE ALLOY. Bieber, Clarence G; Covert, Roger A. (to International Nickel Co., Inc.). U. S. Patent 3,510,294. 5 May 1970. Filed 25 Jul 1966.

A hot workable, cold workable alloy capable of retaining bend and kink ductility in fine cold drawn wire at a tensile strength level of at least about 300,000 pounds per square inch contained about 10% to about 16% molybdenum, about 17% to about 21% chromium, not more than about 0.5% carbon, up to about 2% niobium, up to about 2% tungsten, up to about 3% tantalum, up to about 2% vanadium, up to about 0.25% manganese, up to about 0.5% silicon, not more than 1% copper, not more than 8% iron, up to about 10% cobalt, at least one deoxidizing element from the group consisting of aluminum, titanium and boron, a desulfurizing amount of magnesium, and the balance essentially nickel. (auth)

32342 ZASHCHITNYE POKRYTIYA NA METALLAKH. VYPUSK 3. (Protective Coatings on Metals. Number 3). Samsonov, G. V. (ed.). Kiev; Naukova Dumka (1970). 276p.

Thirty-nine articles are included on theoretical and practical problems in forming protective coatings on metals. Kinetics of formation, structure and utilization of protective coatings, diffusion layers, thermodynamic processes, saturation from gaseous and sublimation phases, are discussed. Various chemical-thermal treatments, glow discharges and other means, used to improve present practices, are analyzed. (R.V.J.)

32343 EFFECT OF DISSOLUTION OF OXIDE FILM ON OXIDATION OF Zr–1 PERCENT Nb ALLOY IN AIR AND PRESSURIZED STEAM AT 450 C. El-Shanshoury, I. A.; El-Dahshan, M. E. (Atomic Energy Establishment, Cairo). Corrosion; 26: 131-4(Apr 1970).

The corrosion behavior of oxidized and vacuum annealed Zr-1% Nb alloy was investigated at 450°C in air and pressurized steam. The corrosion resistance of partially dissolved oxide films was found to decrease with the increase in the vacuum annealing temperature up to 600°C. A linear relationship between the logarithm of the oxidation rate and the annealing temperature was obtained from which an activation energy of 39.5 Kcal/mole was calculated. The activation energy was found to be independent of the corrosive medium. The increase in corrosion rate is explained by the fact that oxygen ion vacancy gradient increases with the increase in the annealing temperature. The decrease of the corrosion rate in steam after vacuum annealing is attributed to the release of H_2 and H during the treatment process. (auth)

32344 THE APPLICABILITY OF ISOTOPIC TECHNIQUES IN STUDYING ENDOGENEOUS INCLUSIONS IN STEEL. Michalik, J. (Institut fuer Kernforschung, Swierk, Poland). Isotopenpraxis; 5: 299-301(Aug 1969). (In German).

The applicability of isotope techniques for the study of endogenous oxide inclusions occur during deoxidation of steel primarily through Fe, Mn, Al, Si, and Ca; they also occur as secondary oxidations during casting in which case oxides of iron and of alloys appear. To determine the inclusions, two methods are discussed: neutron activation analysis and radioactive tracer labeling. Principals for the selection of proper labeling materials from a thermochemical and thermodynamic standpoint are presented. The labeling material is added either to the melted steel or in the deoxidation procedure. (H.B.G.)

32345 ZIRCONIUM INTERMETALLIC COMPOUNDS AND THEIR INFLUENCE ON OXIDATION RATE OF ZIRCONIUM ALLOYS. Evstyukhin, A. I.; Korobkov, I. I.; Osipov, V. V. At. Energ. (USSR); 28: 201-6(Mar 1970). (In Russian).

Data obtained on the influence of intermetallic compounds on corrosion of zirconium showed that in oxygen and water vapor media, at 400 to 800°C pure intermetallides $ZrFe_2$, $ZrMo_2$, Zr_2Ni, Zr_4Sn, and Zr_2Cu are much more rapidly corroded than pure zirconium. The compound $ZrMo_2$ showed the slowest rate of corrosion while Zr_2Ni had the highest. The Zr_4Sn showed a low rate of oxidation at 300 to 400°C and rapid increase at higher temperatures. Microhardness analysis of the compounds revealed a weakening of the Zr_2Ni, Zr_4Sn, and Zr_2Cu at 350 to 450°C. However, $ZrMo_2$ and $ZrFe_2$ compounds retained their initial hardness up to 700°C. (R.V.J.)

32346 INVESTIGATION OF CERMET TITANIUM–MOLYBDENUM ALLOYS. Arensburger, D. S.; Pugin, V. S.; Fedorchenko, I. M. (Inst. of Problems in Studies of Materials, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 32-8(Apr 1970). (In Russian).

An investigation of technological parameters of production and properties of cermet alloys on titanium base containing up to 50% of Mo by weight is reported. Investigation of corrosion properties

of alloys in the medium of 40% sulfuric and 20% hydrochloric acids at indoor and elevated temperatures showed that the composition $Ti^{33}Mo$ which is recommended as a base for production of porous penetrable materials possesses the highest corrosion resistance. (auth)

32347 SCANNING ELECTRON MICROSCOPY OF SODIUM-CORRODED MATERIALS. Berkey, E. (Westinghouse Electric Corp., Pittsburgh); Whitlow, G. A. Trans. Amer. Nucl. Soc.; 13: 141-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Preparation and Fabrication

Refer also to abstracts 31530, 31532, 31603, 31604, and 32909.

32348 (GEMP-744) A SUMMARY OF TUBE FABRICATION STUDIES USING PLANETARY SWAGER. Collins, C. G. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). Jun 1970. Contract AT(40-1)-2847. 27p. Dep. CFSTI.

The capabilities of the planetary swager were studied to determine the feasibility of its use in the fabrication of clad fuel pins for fast breeder reactors. The operating principles of the swager are outlined together with observations of its capacity relative to tube wall thickness, reduction per pass, and draw speed as applied to four austenitic stainless steels. An empirical procedure for predicting deformation parameters of a material worked in the swager is also described. It is concluded that fuel pins can be fabricated from commercial tubing provided the starting tube size is selected within the swager's capacity. (auth)

32349 (WARD-3791-44) WELDING STAINLESS STEEL FUEL ELEMENT END PLUG CLOSURES. DeKlever, R. C.; Jacoby, W. R.; McGeary, R. K. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb 1970. Contract AT(30-1)-4135. 29p. Dep. CFSTI.

Liquid metal fast breeder reactor fuel elements typically consist of thin wall (circa 10 mils) stainless steel tubing containing uranium–plutonium ceramic fuel pellets. A TIG welding process was developed and used to fabricate experimental irradiation pins containing (U,Pu)C fuel immersed in sodium which required welding large stainless steel plugs inserted into the tube ends. Although this method has been adopted and applied by many laboratories, it is prone to the formation of defects attributable to nonuniform tube metal melting and soldification. Development results for solution annealed and 20% cold worked AISI 316 tubing are presented. Discussion centers around the types and causes of the random defects that may occur for extensively refined procedures and equipment. The merits of various nondestructive and destructive testing methods for weld quality are presented. The importance of scrupulous adherence to parts dimensions, fitup, electrode configuration and positioning, and control of other process variables is illustrated. (auth)

32350 SOME OBSERVATIONS OF ETCH PITS IN INDIUM. Dasarathy, Cuppam (Oxford Univ.). Prakt. Metallog.; 7: 281-3(May 1970). (In German and English).

Development of an etch-pit technique applicable to In samples is described. Freshly prepared reagent solution composed of HNO_3 47%, HCl 50%, and HF 3% is used to produce clearly defined pits which outline prior grain structure. Surface relief effects are produced. (J.R.D.)

32351 STANDARD METHOD FOR MACRO-ETCHING METALS AND ALLOYS. 2. SPECIFIC PREPARATION PROCEDURES AND RECOMMENDED SOLUTIONS. Prakt. Metallog.; 7: 268-80(May 1970). (In German and English).

Preparation of etching solutions for Al, Be, Co, Co alloys, Cu, Cu alloys, Fe, steel, stainless steel, and heat-resisting alloys, are described. (J.R.D.)

32352 INVESTIGATION OF THE HOT PRESSING PROCESS OF TUNGSTEN AND ITS PSEUDOALLOYS. COMMUNICATION I. Karpinos, D. M.; Kravchenko, A. A.; Pilipovskii, Yu. L.; Tkachenko, V. G.; Shamatov, Yu. M. (Inst. of Problems in Studies of Materials, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 26-31(Apr 1970). (In Russian).

An experimental investigation was carried out of the hot pressing process of powders of tungsten and the bicomponent systems tungsten–copper, tungsten–silver, and tungsten–tin. A dependence was established of density and compaction velocity on the condition parameters and the effect of the latter on the structure of the material was investigated. The presence of a liquid phase is shown to intensify the compaction process in the initial period due to facilitation of particle regrouping and composing. The intensification degree grows with the increase of liquid phase quantity. (auth)

32353 ENGINEERING USES OF FILAMENT REINFORCED METAL-MATRIX COMPOSITES. Alexander, John A. (TRW, Inc., Cleveland). Metals Eng. Quart.; 10: No. 2, 22-40(May 1970).

A summary is given of the most prominently investigated filament-reinforced metal–matrix systems and the various methods used to fabricate them. Hot-pressure bonding, liquid metal infiltration, electrodeposition, plasma spraying, chemical vapor deposition, cold pressing and sintering, extrusion and rolling, and high energy rate forming methods are discussed in relation to their application in fabricating the filament-reinforced composite systems. Of these, the greatest emphasis was placed on hot-pressure bonding techniques. Problems which are inhibiting the practical engineering use of metal composites include the inconsistency of mechanical properties of the composites, cost of raw materials and fabrication methods, and limited flexibility of form and size. (G.M.C.)

32354 ELECTROSLAG REMELTING OF SUPERALLOYS: PRODUCTION MELTING EXPERIENCE. Elliott, C. F.; Evans, D. C.; Kennedy, R. L.; Manning, C. R. Metals Eng. Quart.; 10: No. 2, 46-50(May 1970).

Consumable electroslag remelting (ESR) of superalloys is reviewed and compared with vacuum arc remelting (VAR), the most common production technique for superalloys today. In the US, the ESR process is used primarily for solution-strengthened alloys such as Hastelloy X, while some of the precipitation-strengthened alloys are melted in Europe and Russia by this process. In order to evaluate the ESR process for the manufacture of superalloys a comparison was made of the process complexity, cost, chemistry control, shape, yield, and refining and macrostructure for both ESR and VAR remelting methods. (G.M.C.)

32355 USE OF POST-ACTIVATION TECHNIQUE TO TRACE THE ORIGIN OF ALUMINATE INCLUSION IN STEEL. Inamoto, Kinya; Sato, Hideki (Nippon Kokan Kabushiki Kaisya, Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 238-40(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A post-activation technique, employing stable lanthanum, was used to investigate the source of alumina inclusion in rimmed steel. The experimental procedure is described, and an equation presented which relates the weight of Al_2O_3 inclusion determined by measured La values using the activation method to the Al_2O_3 weight determined by chemical analysis. (L.C.L.)

32356 STUDY OF THE SOLIDIFICATION OF STEEL INGOTS BY RADIOTRACERS. Kohn, A. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 560-8(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The solidification of steel ingots was studied using ^{198}Au and ^{192}Ir as tracers. The methods used and the autoradiographs obtained are described. (L.C.L.)

32357 DER NUKLEARE BRENNSTOFFKREISLAUF. Tagung vom 26. Maerz 1969, Haus der Technik e.V., Essen. (Nuclear Fuel Cycle. Meeting of March 26, 1969, House of Technology, Essen). Haus der Technik-Vortragsveroeffentlichungen, Heft 214. Essen; Vulkan-Verlag Dr. W. Classen (1969). 84p. (CONF-690338).

Six papers were presented at the Nuclear Fuel Cycle Meeting. A separate abstract was prepared for each. (J.S.R.)

For abstracts of individual papers see: 31460, 31516, 31574, 31671, 32358, and 32359.

32358 SUPPLY OF ENRICHED URANIUM. Jelinek-Fink, Peter (Nuklear-Chemie und -Metallurgie GmbH, Wolfgang, Ger.). pp 15-28 of Der Nukleare Brennstoffkreislauf. Essen; Vulkan-Verlag Dr. W. Classen (1969). (In German).

From Meeting of House of Technology, Essen, Germany. See CONF-690338.

The use of enriched uranium as a fuel for nuclear reactors is discussed. The concepts underlying all methods for the enrichment of uranium are described. The present and future needs for separation installations and the present enrichment capacities are estimated. The purchase of enriched uranium by the toll enrichment methods is considered. Structure of the separation costs of the U.S. gaseous diffusion installations is evaluated. The European enrichment installations are also considered from the cost structure viewpoint. (J.S.R.)

32359 NEW PROBLEMS IN FUEL ELEMENT FABRICATION. Stoll, Wolfgang (Alkem Alpha-Chemie und -Metallurgie GmbH, Leopoldshafen, Ger.). pp 29-43 of Der Nukleare Brennstoffkreislauf. Essen; Vulkan-Verlag Dr. W. Classen (1969). (In German).
From Meeting of House of Technology, Essen, Germany. See CONF-690338.

New problems in fuel element fabrication are discussed with respect to light water reactors, conversion methods, ceramic fuels, rod production, rod claddings, assembly of the rods, fuel elements for natural uranium-heavy water reactors and high temperature reactors, fast breeder fuel elements, and materials testing reactors. The returning of Pu to thermal reactors is also considered. (J.S.R.)

32360 STRESS-FREE BONDING OF LAMINATED MOLYBDENUM PERMALLOY CORES. Kehr, William D.; Brock, George W. (IBM Systems Development Div., Boulder, Colo.). IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-6: 27-30(Mar 1970).

Conventional adhesive bonding caused reductions of 50 percent or more in the 100-gauss magnetic permeabilities (at frequencies of 60 to 5×10^5 Hz) of laminated 4-79 molybdenum Permalloy cores. Oxidizing the laminations prior to adhesive bonding decreased these reductions as much as 50 percent. A method of stress-free joining was developed using simultaneous annealing and diffusion bonding of laminations which had been either preoxidized or coated with magnesium methoxide. Cores fabricated in this manner exhibited permeabilities similar to unbonded cores at low frequencies, and permeabilities higher than conventional adhesively bonded cores at high frequencies. (auth)

32361 PREPARATION OF ALIGNED COMPOSITE MATERIALS BY UNIDIRECTIONAL SOLID-STATE DECOMPOSITION. Carpay, F. M. A. (Philips Research Labs., Eindhoven, Netherlands). Acta Met.; 18: 747-52(Jul 1970).

Analogous to the alignment of lamellar eutectic structures by means of unidirectional solidification, the discontinuous decomposition of eutectoids and supersaturated solid solutions appears to yield aligned lamellar specimens under unidirectional cooling conditions. Experiments are described concerning the eutectoids in the systems Co–Si, Cu–Al, Cu–In and Ni–In and the supersaturated solid solution of Sn in Pb. The lamellae occurring upon decomposition are parallel to the temperature gradient throughout the samples and parallel to each other over lengths of mm (Co–Si, Ni–In, Cu–Al, Pb–Sn) or cm (Cu–In). For the eutectoid decomposition of Co_3Si the experimental relationship between the interlamellar spacing λ (varying between 0.1 and 1 μm) and the decomposition rate R appears to be $\lambda^4 R$ = constant. At relatively high rates (depending on the system) the parallelism of the lamellae is lost. (auth)

32362 PREPARATION AND PROPERTIES OF HIGH-PURITY VANADIUM AND V–15Cr–5Ti. Wand, C. T.; Baroch, E. F.; Worcester, S. A.; Shen, Y. S. (Wah Chang Corp., Albany, Oreg.). Contract AT(30-1)-3742. Met. Trans.; 1: 1683-9 (Jun 1970).

A process was developed to prepare high-purity vanadium consisting of an aluminothermic reduction of vanadium pentoxide followed by electron beam purification. The purity of the vanadium product was greater than 99.9% with typical total interstitials of 350 ppM, silicon content of 300 ppM, and other metallic impurities being below the limit of detection. Cold-rolled, unalloyed material recrystallized fully at 980°C, with a microhardness of 60 dph in the recrystallized condition. Ingots of V–15Cr–5Ti alloy were produced by arc melting, and fabricated to sheet forms. Purity of the alloy was comparable to that of the base metal. This sheet material recrystallized fully at 1050°C with a microhardness of 200 dph in the recrystallized condition. (auth)

32363 FURTHER DEVELOPMENT OF THERMAL SWITCH COMPOSITE REENTRY PROTECTION MATERIALS. Princiotta, Frank T.; Barr, Harold N. (Hittman Associates, Inc., Columbia, Md.). Trans. Amer. Nucl. Soc.; 13: 52(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32364 EXTRUSION OF REFRACTORY METALS FOR ISOTOPE FUEL CAPSULES. McDonald, R. E.; Donnelly, R. G.; Schaffhauser, A. C. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 84-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32365 CHEMICAL-VAPOR-DEPOSITED TUNGSTEN CAPSULES FOR RADIOISOTOPE SOURCES. Haff, K. W.; Federer, J. I.; Martin, W. R.; Ramey, D. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 85-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32366 WELDING PROCEDURES FOR LMFBR VESSELS. Slaughter, G. M.; Goodwin, G. M. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 117-20(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32367 VALVE DESIGNS AND MATERIALS FOR LMFBR. Milleville, B. J.; Douty, R. A. (Rockwell Mfg. Co., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 123-4(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32368 CORROSION-RESISTANT COATINGS FOR MSBR REPROCESSING EQUIPMENT. Poteat, L. E.; Federer, J. I. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 164-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32369 ELECTROCHEMICAL METHOD FOR DISSOLUTION OF METALLIC TUNGSTEN. Yurkevich, Yu. N.; Shapiro, K. Ya.; Kolenkov, V. V.; Funtikova, E. I. (to All-Union Scientific Research Inst. of Hard Alloys). Russian Patent 233,922. 2 Sep 1969. Filed 14 May 1966. (In Russian).

An electrochemical method for dissolution of metallic tungsten, distinguished by its objective to improve purity and metallicity, is proposed. Metallic tungsten is subjected to anodic dissolution in mineral acids. Solid tungsten is anodically dissolved in concentrated HCl at 60 to 70°C and D = 2 to 3 A/cm^2. To reprocess tungsten waste, it is anodically dissolved in concentrated HCl at 60 to 70°C and D = 3 to 5 A/cm^2. Solution of lower oxides is oxidized using HNO_3 and the filtered tungstic acid is roasted. (JPRS)

32370 PRECIPITATION HARDENING OF THE Fe–30 PERCENT Ni–9 PERCENT Ta ALLOY. Cozar, R.; Rigaut, G.; Pineau, A. (Ecole des Mines, Paris). Scr. Met.; 3: 883-6(Dec 1969). (In French).

The precipitation hardening of an Fe–30% Ni–9% Ta alloy, prepared in a vacuum induction furnace, forged into 22 × 22 mm squares at 1180°C, homogenized at 1180°C for 60 hr, and then forged into rounds of 8-mm diameter was measured. The temperature range for the study of the precipitation was determined by dilatometry. Four temperatures of isothermal aging were used: 550, 650, 700, and 750°C. For each of the temperatures, the variation of the hardening was determined by Vickers hardness at 30 kg. The observations were made by optical and electronic microscopes on extraction replicas and thin foils. The studies confirmed earlier results obtained concerning alloys less rich in Ta with respect to the morphology and structure of the precipitates. The kinetics of the precipitation is greatly increased as the supersaturation in Ta is increased. (J.S.R.)

Properties Evaluations

Refer also to abstracts 31576, 31607, 31638, 32365, 32498, and 33176.

32371 (BM-RI-7393) DEVELOPMENT OF HIGH-TEMPERATURE VANADIUM-BASE ALLOY. Keith, George H.; Winston, J. S. (Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center). Jun 1970. 13p.

A vanadium-base alloy consisting of the following elements in weight percent—molybdenum, 20; titanium, 10; carbon, 0.1; silicon, 0.5; and yttrium, 0.5—had exceptionally high strength at temperatures up to 1,200°C. This alloy was capable of fabrication to sheet of ~1 mm thickness by a combination of hot swaging and hot and warm rolling. In the warm-rolled condition at ambient temperature, its ultimate tensile strength was 1,205 MN/m^2. The strength at 1,200°C was 150 MN/m^2. Within the temperature range of 25 to 1,200°C, the ductility of the alloy as measured by elongation increased from 4 to >90%. Strengthening was achieved by both solid-solution and dispersed-phase mechanisms. Alloys of 20% molybdenum and 10% titanium were stronger than the other molybdenum-titanium alloy compositions tested. Strength was increased 15% in the temperature range of 25 to 800°C, with no accompanying loss in ductility, by the addition of 0.5% silicon. Workability was improved by additions of 0.25 and 0.5% yttrium. (auth)

32372 (BNWL-1371) SOME EFFECTS OF COLD-WORKING, THERMAL AGING, AND REACTOR IRRADIATION ON ULTRASONIC WAVES VELOCITY AND ATTENUATION IN SOME AUSTENITIC STEEL TENSILE-CREEP SPECIMENS. Hunter, D. O. (Battelle-Northwest., Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT(45-1)-1830. 33p. Dep. CFSTI.

For nondestructive testing purposes, austenitic steel specimens which were cold worked, thermally aged, or fast flux irradiated were measured for effects on ultrasonic waves velocity and attenuation. This report presents a summary of ultrasonic measurements made on tensile-creep specimens of irradiated Types 304 and 348 stainless steel (SS), cold-worked Types 304 and 316 SS and thermally aged Type 304 SS. Cold working was found to affect both attenuation and velocity; the direction and amount of change depended on the type of steel alloy, the percentage of cold-working and the frequency of ultrasonic waves. Thermal aging had negligible effect on velocity and attenuation. Neutron bombardment to high fluences (0.85×10^{22} to 3.7×10^{22} nvt) at high irradiation temperatures (825 to 1180°F) typically caused decreases in velocity. (auth)

32373 (NBS-SPEC. PUBL-315-3) BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS, JULY, AUGUST, SEPTEMBER 1969. Diamond, J. J. (ed.) (National Bureau of Standards, Washington, D. C. International Union of Pure and Applied Chemistry. Commission on High Temperatures and Refractories). Oct 1969. 87p. GPO $1.00.

A bibliography on the high-temperature chemistry and physics of materials is presented. Part I of the bibliography is concerned with solids and liquids; Part II with gases. About 825 references are included. (J.R.D.)

32374 (NP-tr-1892) VARIATION IN THE TECHNOLOGICAL PROPERTIES OF Zr REFRACTORIES IN DEPENDENCE ON THE DEGREE OF ZrO_2 STABILISATION. Klyucharov, Ya. V.; Strakhov, V. I. Translated by S. Dobrianskyj for Australian Atomic Energy Commission, from Izv. Akad. Nauk SSSR, Neorg. Mater.; 4: 1502-6(Sep 1968). 10p. Dep. CFSTI (U. S. Sales Only).

An abstract of this article, prepared from the original, appeared as NSA 23: 10282 (1969). (France)

32375 (ORNL-TM-2849) CONCEPTUAL SYSTEM DESIGN DESCRIPTION OF THE INTERMEDIATE VESSEL TESTS FOR THE HEAVY SECTION STEEL TECHNOLOGY PROGRAM. Segaser, C. L. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 87p. Dep. CFSTI.

The Heavy Section Steel Technology Program has among its objectives the demonstration of the capability to predict failure of flawed, heavy-wall pressure vessels tested under frangible, transitional and tough loading regimes. A series of tests intermediate between conventional laboratory tests and a full-scale vessel test are planned to permit characterization of the many parameters that influence fracture in an actual vessel. Since hydrostatic rupture of a thick-wall pressure vessel by brittle fracture can result in generation of high velocity missiles, the tests must be conducted under adequately safe conditions with the high-pressure equipment behind approved barricades. The conceptual design of a system and its associated equipment for safely conducting fracture tests at pressures up to 30,000 psig on the proposed vessels at wall temperatures ranging from about -50 to +350°F is described. These temperatures are estimated to bracket the anticipated vessel wall transition temperature. At least ten such tests are currently planned in the simulated service test program. (auth)

32376 (WANL-TME-1986) CRYOGENIC BERYLLIUM BIAXIAL STRESS TEST. Development Test Report. Data Item T-119. Baker, W. H.; Kesterson, R.; Opdycke, D. G. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Apr 1970. Subcontract NP-1. 70p. Dep. CFSTI.

Uniaxial and biaxial beryllium specimens were stressed to failure at -320°F (approximate reflector inlet temperature) and the results compared. The hollow beryllium biaxial test specimens were simultaneously subjected to axial and hoop stresses of a 1:1 ratio at the specimen ID. Each test was run until the specimen is fractured. The experimental data were analyzed and compared with various theories of failure. Only three of the four biaxial specimens of the same material stock were compared and the data were scattered and fell between the Stassi d'Alia and the Von Mises theories of failure. (auth)

32377 (WCAP-7368) HEAVY SECTION STEEL TECHNOLOGY PROGRAM. TECHNICAL REPORT NO. 4, OCTOBER 1969. A TWO-DIMENSIONAL ELASTIC-PLASTIC ANALYSIS OF FRACTURE TEST SPECIMENS. Visser, C.; Gabrielse, S. E.; VanBuren, W. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Aug 1969. Contract W-7405-eng-26; Subcontract 3088. 178p. Dep. CFSTI.

For Oak Ridge National Lab., Tenn.

The elastic-plastic analysis of fracture test specimens with realistic material properties is extremely difficult. No exact solutions are known. At the present time the finite element method is the best method available to analyze the complex shapes of actual test specimens. The development of finite element procedures and computer programs for the elastic-plastic analysis of fracture test specimens under both plane stress and generalized plane strain conditions is described. Since very large strains and strain gradients occur in the vicinity of the crack tip, the procedures and programs are based on the principle of virtual work for large deformations and strains as well as a triangular element with a higher order displacement field. (auth)

32378 STUDY OF THE INTERSTITIALLY RELATED HARDENING ZONES OF NIOBIUM BY VARIATION IN THE OXYGEN CONCENTRATION AND IN THE TENSILE DEFORMATION RATE. Mazot, Philippe (Ecole Nationale Superieure de Mecanique et d'Aerotechnique, Poitiers, France). Compt. Rend., Ser. C; 270: 1089-92(23 Mar 1970). (In French).

Tensile tests made in vacuum from 20 to 1000°C revealed a succession of hardening peaks for niobium. Through the analysis of the metal deformation rate and the oxygen concentration, the main factors interfering with the intensity of these peaks were determined, and their temperature displacements interpreted. These peaks were also characterized in relation with the various interstitials present in niobium. (auth) (France)

32379 PROTECTION OF ZIRCONIUM ALLOYS AGAINST HYDRIDING IN ORGANIC COOLANTS. Hatcher, Stanley R.; Boulton, John (to Atomic Energy of Canada Ltd.). U. S. Patent 3,508,861. 28 Apr 1970. Filed 2 Sep 1965.

A method is given for reducing the accelerated hydriding of zirconium alloys exposed to organic coolants contaminated with chlorine by maintaining a concentration of at least 60 ppM of water in the coolant. (auth)

32380 DIFFUSION DATA. VOLUME 4, NUMBER 1, 1970. Woehlbier, F. H. (ed.). Diffus. Data; 4: No. 1, 1-183(1970).

A compilation of data on mass transport in inorganic solids and their melts is presented. Information is included on diffusion coefficients, isotope effects, thermotransport, electrotransport, permeation of gases, and experimental techniques. (J.R.D.)

32381 STRESS CORROSION CRACKING OF Ti-8Al-1Mo-1V ALLOY: ELECTROCHEMICAL BEHAVIOR IN AQUEOUS SOLUTIONS. Chen, C. M. (Air Force Materials Lab., Wright-Patterson AFB, Ohio); Beck, F. H.; Fontana, M. G. Corrosion; 26: 135-40(Apr 1970).

The electrochemical behavior of material/environment systems has a significant effect on susceptibility to stress corrosion cracking. The present investigation was concerned with electrochemical processes associated with stress corrosion cracking of Ti-8-1-1 in aqueous environments. Also included are fresh surface potentials measured by an erosion corrosion method; the slope of potential vs pH was about 59 mV/pH. Potential decay curves in sulfuric acid displayed two arrests and, the slope of potential vs pH for both was about 55 mV/pH. In chloride containing solution, chloride ion attack occurred at potentials more noble than about 2000 mV. A plot of logarithmic current and time yields the linear relationship, $\ln J = At + B$, where A and B are constants and t is time. (auth)

32382 STRESS CORROSION CRACKING OF Ti AND Ti-6Al-4V ALLOY IN DINITROGEN TETROXIDE. Moreland, P. J.; Boyd, W. K. (Battelle Memorial Inst., Columbus, Ohio). Corrosion; 26: 153-9(Apr 1970).

The stress corrosion cracking behavior of titanium and Ti-6Al-4V alloy in liquid N_2O_4 was investigated from thermodynamic considerations and autoradiographic, chemical, and potential studies. Studies were concerned with the $N_2O_4-H_2O-O_2$ system which is believed to produce HNO_3 and the $N_2O_4-O_2$ system to cause stress corrosion cracking. A hydrogen embrittlement mechanism involving HNO_3 in the commercial N_2O_4 appeared improbable. An electrochemical mechanism in which O_2 plays a major role has been proposed. (auth)

32383 EFFECT OF CORROSIVE ENVIRONMENT ON CRACK PROPAGATION IN ALPHA BRASS AND A COPPER-BERYLLIUM ALLOY. Sylwestrowicz, W. D. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Corrosion; 26: 160-70(Apr 1970).

Notched specimens of a copper-beryllium alloy and of α-brass were tested in tension in an ammonia-containing solution. Specimens were strained at rates ranging from 0.5 to 5×10^{-4} cm/min. Formation of a plastically deformed zone at the root of the notch appeared to be essential to the formation and propagation of the crack. A smaller amount of plastic deformation was needed to start a crack in the corrosive solution than in air. The observation that the effect of the corrosive solution seems to be independent of the strain rate suggests than an adsorption process contributes to specimen failure in stress corrosion fracture. (auth)

32384 STRENGTH OF NIOBIUM–OXYGEN SOLID SOLUTIONS. Ravi, K. V.; Gibala, R. (Case Western Reserve Univ., Cleveland). Acta Met.; 18: 623-34(Jun 1970).

Single crystals of high purity niobium and niobium–oxygen alloys were deformed in tension at temperatures between 4.2 and 550°K. At room temperature and above, the yield stress increased monotonically with oxygen content over the entire range of compositions investigated (to ~4300 at. ppM). At lower temperatures alloy softening was observed, i.e., the yield stress and its temperature dependence decreased with initial additions of oxygen to approximately 500 at. ppM. With larger solute contents, the yield stress increased monotonically, similar to results at higher temperatures. Correspondingly, the activation enthalpies and volumes at a constant effective stress first decreased then increased as a function of oxygen concentration. These results coupled with others in the literature demonstrate that dislocation–interstitial solute interaction is the dominant deformation mechanism of b.c.c. metals at low temperatures. Furthermore, both interstitial and substitutional alloy softening are the result of solute association (scavenging) processes in solid solution. (auth)

32385 OBSERVATIONS ON SUPERCONDUCTORS BY ELECTRON MICROSCOPY. Kraegeloh, Ulrich (Max-Planck-Institut fuer Metallforschung, Stuttgart. Univ., Stuttgart). Prakt. Metallog.; 7: 235-41(May 1970). (In German and English).

After a brief comment on the phenomenon of superconductivity the lattice defects occurring in the flux line lattice are discussed and illustrated with electron micrographs. (auth)

32386 EFFECT OF ANNEALING TEMPERATURE ON THE DUCTILE-BRITTLE TRANSITION TEMPERATURE OF CAST MOLYBDENUM OF CONSTANT GRAIN SIZE. Thornley, J. C.; Wronski, A. S. (Univ. of Bradford, Eng.). J. Less-Common Metals; 21: 205-11(Jun 1970).

The ductile-brittle transition temperatures of cast molybdenum specimens with constant grain size, obtained by annealing at different temperatures, were determined. The mechanical properties of all specimens in their respective transition regions are given. As the annealing temperature, T_A, was increased, T_T decreased from ~222 to ~153°K. Increasing the grain diameter by more than an order of magnitude, either by increasing the T_A or by strain-annealing, did not change T_T from 153°K by more than 4°K. (G.M.C.)

32387 FRACTURE INITIATION IN GROUP VIA METALS. Gilbert, A. (University Coll., Swansea, Eng.). J. Less-Common Metals; 21: 212-14(Jun 1970).

Investigations into the brittle fracture of the Group VIB refractory metals showed that the larger grain-boundary precipitates present in less-pure refractory metals could be the preferred sites for the initiation of cleavage. Examples are given for chromium and tungsten. (G.M.C.)

32388 METALLOGRAPHIC OBSERVATIONS ON SLOW CRACK GROWTH IN BERYLLIUM MONOCRYSTALS. Govila, R. K. (Martin Marietta Corp., Baltimore). J. Less-Common Metals; 21: 215-22(Jun 1970).

Investigations of slow crack growth in monocrystalline beryllium some new features along the length of the crack were observed on the edge of the crystal and on (0001) cleaved plane. Some possible explanations are given for the following features: transition region, prismatic and basal slip, blunting of the crack tip due to twins, and deviation of the primary (0001) cleavage crack from its original path to a prismatic-type, $\{11\bar{2}0\}$, plane. (G.M.C.)

32389 FLOW STRESS AND DISLOCATION STRUCTURES IN POLYCRYSTALLINE MOLYBDENUM. Karashima, Seiichi; Oikawa, Hiroshi; Igarashi, Tadashi (Tohoku Univ., Sendai). J. Jap. Inst. Metals; 34: 389-93(Apr 1970). (In Japanese).

The flow stress of polycrystalline molybdenum of commercial purity was determined in the temperature range 20 to 940°C, and the result was discussed in comparison with the dislocation structure obtained by transmission electron microscopy. The flow stress decreased markedly with a rise in temperature between 20 and 350°C. In this temperature range, except at 200°C, the work-hardening rate was almost independent of deformation temperature, while above 500°C it decreased as the temperature increased. The increase in the dislocation density was proportional to the strain in an early stage of deformation, but the rate of increase in the dislocation density became smaller at the strain where well-defined cell-structures was observed. The non-uniformity of the dislocation distribution increased as the deformation temperature between 20 and 500°C, but it was almost independent of strain once dislocation tanglings were formed. The increase in flow stress as the deformation proceeded was proportional to the square-root of dislocation density in a dislocation-concentrated region. The proportionality factor α' was about 0.19 between 20 and 900°C, except at 200°C. The flow stress, dislocation density, and the relation between the two show anomalous behaviors at temperatures near 200°C. (auth)

32390 DIRECTIONAL MAGNETIC PROPERTIES AND STRUCTURES IN THE $SmCo_5$–$SmCu_5$ SYSTEM ALLOY. Kimura, Yasuo; Kamino, Kimiyuki (Technical Research Lab., Tokyo). Trans. Jap. Inst. Metals; 11: 132-8(Mar 1970).

The coercive force ${}_BH_C$ of the intermetallic compound $SmCo_5$ is not sufficient for its application as a permanent magnet in the cast state. Increasing of the coercive force of the $SmCo_5$ alloy system was investigated. Specimens are melted in an arc melt furnace which has the tungsten electrode and inactive gas Ar. The directional magnetic properties are observed in the $SmCo_5$–$SmCu_5$ system alloy, as a result of freezing in a direction normal to the cold surface of the copper hearth. The maximum energy product, $(BH)_{max}$, of the 65 wt% $SmCo_5$–35 wt% $SmCu_5$ alloy has 5.78 MGOe in the as-cast state, when the measurement is carried out in a direction perpendicular to the chill plane. By annealing at 300°C for 1 hour, the $(BH)_{max}$ value increases to 7.73 MGOe with Br 6450 G and ${}_BH_C$ 3400 Oe. The magnetic properties in the direction perpendicular to the chill plane are superior to those in other directions and the chill plane shows a weak texture, (0001). These alloys have the easy direction of magnetization, which is the c-axis of the hexagonal crystal as in the case of $SmCo_5$. The lattice constants of both a- and c-axes of the hexagonal crystal enlarge linearly with increasing copper content in alloy. The value of lattice constant ratio c/a keeps approximately 0.802 in all the alloys investigated. (auth)

32391 PRECIPITATION IN QUENCHED AND AGED BERYLLIUM CONTAINING SMALL AMOUNTS OF IRON. Morozumi, Shotaro; Furuya, Takemi; Koda, Shigeyasu (Tohoku Univ., Sendai). Trans. Jap. Inst. Metals; 11: 127-31(Mar 1970).

Hardness test, electrical resistivity measurement, and electron microscope observation were carried out on arc-melted beryllium specimens with up to 0.2 wt% iron which were heat-treated at 900°C and aged at 400 to 700°C for various times. From the results it was deduced that the amount of small dislocation loops produced probably by precipitation of excess quenched-in vacancies increased with increasing iron content, and that the vacancies combined preferentially with iron atoms, which resulted in the slowing down of their migration rate. The amount of the loops increased by the subsequent aging, accompanied with the precipitation of iron onto the loops as well as onto other defects such as grain boundaries and dislocation lines. (auth)

32392 CONTRIBUTION TO THE STUDY OF THE MECHANICAL PROPERTIES AT HIGH TEMPERATURES OF NIOBIUM AND THREE OF ITS ALLOYS. Mazot, P.; de Fouquet, J.; Piquereau, J.-Y.; Quintard, M. (Ecole Nationale Superieure de Mecanique et Aerotechnique, Paris). Metaux (Corros.-Ind.); 44: 243-58(Jul-Aug 1969). (In French).

Tensile tests were made on Nb, Nb–0.05% C, Nb–1% Zr–0.2% C, and Nb–5% W–1% Zr–0.2 C in the temperature range from 20 to 1200°C. The tests confirmed the existence, in the four alloys studied, of a relative hardening zone in this temperature range, characterized principally by a strong consolidation. The elastic limit was affected only in the case of tensile curves having a plateau or at least a relaxing at the end of the elastic rise, that was only for nonalloyed Nb below 700°C. The evolutions of σ_E and σ_R for nonalloyed Nb, and especially of the ductility, showed that this hardening zone was divided into several regions; the temperature position of each of them remained essentially the same for the four alloys. The presence of Zr and W had the effect, in addition to a decided improvement of the mechanical properties, of extending the relative hardening zone toward the high temperatures as a result of the appearance of new regions. The Nb–C alloy was the least interesting from all point of view; this was confirmed by its fatigue behavior. These fatigue tests revealed a relative increase of the resistance to fatigue of unalloyed Nb with respect to the other alloys at 250°C, which recalled the behavior of extra-soft steel in the region of blue fragility. The influence of the fatigue rate is extremely difficult to explain from the raw tensile curves. The study of the mechanisms associated with each of the zones observed showed the intervention of interactions of the dislocation–interstitial, dislocations-substitutionals-interstitials, and dislocation-precipitates types. (tr-auth)

32393 EVALUATION OF TWO NICKEL-BASE ALLOYS, ALLOY 713C AND NASA TAZ-8A, PRODUCED BY EXTRUSION OF PREALLOYED POWDERS. Freche, John C.; Waters, William J.; Ashbrook, Richard L. (Lewis Research Center, Cleveland). Metals Eng. Quart.; 10: No. 2, 58-9(May 1970).

The mechanical properties of two nickel-base alloys produced by extrusion of prealloyed powders were compared with the re-

spective cast alloys. The effects of various heat treatments on the mechanical properties and microstructure of the extruded Alloy 713C and TAZ-8A alloys were also evaluated. (G.M.C.)

32394 NICKEL-BASE ALLOY WITH IMPROVED STRENGTH AT 2000 TO 2200 F. Waters, William J.; Freche, John C. (Lewis Research Center, Cleveland). Metals Eng. Quart.; 10: No. 2, 55-7(May 1970).

A nickel-base alloy, WAZ-20, with a nominal composition of 17 to 20% W, 6 to 7% Al, 1.4 to 1.6% Zr, 0.10 to 0.20% C, and the remainder Ni, was developed for potential application to the stator vanes of advanced turbine engines. It had high incipient melting temperature, high strength at 1205°C, high impact resistance, as well as microstructural stability. (G.M.C.)

32395 PERMEABILITY–STRENGTH RELATIONSHIPS IN POROUS MATERIALS. Rothwell, W. S.; Dolton, T. A. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 740-6(Apr 1970).

Design of systems utilizing porous materials, e.g., transpiration-cooled systems, may place requirements on both mechanical and flow-control (permeability) properties. Equations relating porosity and strength are developed assuming a simple cubic porous structure. The theoretical expressions are then compared with experimental data on porous beryllium and stainless steel materials, and good agreement is shown. Implicit relations are then developed which relate permeability to strength and density, and which include a material-dependent constant that is determined experimentally. Empirical fits to these relations are then manipulated to show some practical design consequences. It is seen that for a given material with required permeability for design, there is an optimum particle size which will yield maximum strength. The maximum strength, which varies with permeability to the minus $\frac{1}{4}$ power, is determined for the beryllium and stainless steel example materials. It is also seen that the relative density, for maximum strength is 0.81 (porosity of 0.19) which is independent of the material and the permeability. (auth)

32396 SUBSTITUTIONAL-INTERSTITIAL INTERACTIONS IN NIOBIUM–1 PERCENT ZIRCONIUM–OXYGEN ALLOYS. Miner, Ronald Earl. Cleveland; Case Western Reserve Univ. (1969). 118p.

Thesis.

The interaction between substitutional and interstitial atoms in niobium containing 1.0 at. % zirconium has been investigated. Internal friction measurements were made on single crystals of pure niobium and niobium 1.0 at. % zirconium containing between 15 and 5300 ppM abs oxygen at a frequency of 50 kHz. The internal friction spectrum in the niobium specimens consisted of the sum of two Snoek peaks due to oxygen and nitrogen and a linear background damping. The behavior of the zirconium-containing alloys was considerably more complex. A digital computer was employed to show that the spectrum could be synthesized on the basis of five Debye peaks, two corresponding to the simple Snoek peaks and three extraordinary peaks resulting from the relaxation of substitutional-interstitial (s – i) defects. In both alloys the synthesis was achieved on the basis of single relaxation time (theoretical breadth) Debye peaks. The basic results thus consist of the orientation and composition dependence of the relaxation strength of the five peaks. Measurements on ⟨100⟩, ⟨110⟩, and ⟨111⟩ oriented specimens showed that the orientation dependence of all the relaxation processes was the same as that for the simple Snoek peaks. The s – i defect symmetry was thereby concluded to be either tetrahedral of ⟨100⟩ orthorhombic. Combining this result with the composition dependence of the behavior showed that the defects responsible for the extraordinary peaks observed are (1) an interstitial oxygen atom on a nearest neighbor octahedral site to a substitutional zirconium atom, (2) an interstitial nitrogen atom on a nearest neighbor octahedral site to a substitutional zirconium atom, and (3) a pair of interstitial oxygen atoms on opposite nearest neighbor octahedral sites around a substitutional zirconium atom. (Diss. Abstr. Int., B)

32397 VANADII I EGO SPLAVY. (Vanadium and Its Alloys). Efimov, Yu. V.; Baron, V. V.; Savitskii, E. M. Moscow; Izdatel'stvo Nauka (1969). 253p.

Vanadium reactors with various elements of the periodic system, phase diagrams of binary and ternary vanadium alloys, and mechanical and physical properties of the alloys and their technological uses are examined and analyzed. (R.V.J.)

32398 PLASTIC DEFORMATION OF A NICKEL–CHROMIUM–NIOBIUM ALLOY QUENCHED IN WATER FROM 1 200°C TO 20°C, THEN TEMPERED AT 700°C. Royer, Alain; Gantois, Michel (Ecole Nationale Superieure de la Metallurgie et de l'Industrie des Mines, Nancy). Compt. Rend., Ser. C; 270: 1273-5(13 Apr 1970). (In French).

The propagation of deformation is due to slip and shear in the matrix and in the precipitates (quadratic precipitates transforming into orthorhombic ones). Deformations due to twinning can result if the lamellae of the orthorhombic precipitate are sufficiently thick. The slip systems and the twinning planes are identified. (auth) (France)

32399 ACOUSTICAL RELAXATIONS IN ALPHA URANIUM AT LOW TEMPERATURES. Oliphant, Robert Walter. Cleveland; Case Western Reserve Univ. (1969). 74p.

Thesis.

Anomalous behavior has been observed in many of the physical properties of alpha uranium. In order to aid in understanding these anomalies, internal friction measurements were made on alpha uranium at temperatures below 50°K. These different techniques were used: a torsional pendulum at 1.5 Hz, a resonant bar technique at 100 kHz and 240 kHz, and a pulse echo technique at 20 MHz. Elastic moduli were also measured with the first two techniques. Two internal friction peaks were observed, one at 37 to 41°K and one at 13 to 23°K. Each peak was associated with a minimum in the modulus. Neither peak appeared to be thermally activated. The lower peak was very sensitive to the metallurgical structure of the specimen. Decreasing the grain size, straining, or quenching, all broadened the lower peak. A magnetic field of 15 kOe had no effect on the internal friction or elastic modulus. A model was proposed to explain the low temperature anomalous behavior of alpha uranium. An electronic transition at 40.5°K is presumed to stabilize the alpha uranium lattice by localizing a fraction of electrons in the hybrid bonds of stable trigonal bipyramids. These stabilized complexes form randomly in the lattice at the transition. At about 23°K the lattice is further stabilized by the ordering of the trigonal bipyramids. The amount of ordering and temperature range of ordering depend on the perfection and extent of internal strains in the specimen. The model satisfactorily accounts for many of the physical property anomalies observed in alpha uranium. (Diss. Abstr. Int., B)

32400 LOW TEMPERATURE RECOVERY BEHAVIOUR OF NITROGEN QUENCHED INTO MOLYBDENUM. Evans, J. H. (Atomic Energy Research Establishment, Harwell, Eng.).; Eyre, B. L.; Birnbaum, H. K. Acta Met.; 18: 835-41(Jul 1970).

In previous work it was shown that quenching molybdenum after high temperature annealing in a nitrogen atmosphere could retain nitrogen in a supersaturated solid solution. Results of a study of the behavior of the nitrogen in Mo on aging are described. The emphasis is placed on studying the aging up to 300°C using resistivity and stress relaxation techniques. The results show that after aging up to 250°C all the nitrogen is removed from solution. Most of this removal takes place in two well defined resistivity stages and evidence is presented that these stages are due to single and dinitrogen removal respectively. Although both stages obey first order kinetics there are some complicating features in the recovery behavior. For example, the measured activation energy for stage A, attributed to single nitrogen migration, varies between 0.93 and 1.19 eV depending on nitrogen concentration while there is an associated change in the position of the peak during isochronal annealing. Also the appearance of a third resistivity stage at high nitrogen contents together with the results of the anelastic behavior show that although the general picture is clear the details of the precipitation processes may be complex. (auth)

32401 INFLUENCE OF MOLYBDENUM ON THE γ PHASE FORMED IN A SYSTEMATIC SERIES OF EXPERIMENTAL NICKEL-BASE SUPERALLOYS. Loomis, Warren Tuttle. Ann Arbor, Mich.; Univ. of Michigan (1969). 94p.

Thesis.

It is generally acknowledged that both molybdenum, a typical refractory element, and the γ' phase play a crucial role in the excellent high-temperature properties characteristic of the nickel-base superalloys. It is generally assumed, however, that their respective contributions to these high-temperature properties are essentially independent of each other. Because of the importance of both the refractory elements and the γ' phase to the nickel-base superalloys, it was concluded that a study to investigate possible interactions between the two might contribute to a better understanding of the nickel-base alloy field in general. A systematic series of experimental alloys was prepared, based on a nickel content of about 75 atomic percent, and a chromium content of about 15 atomic percent. The series of alloys included three aluminum levels, 6.5, 9, and 12 atomic percent aluminum. Some of the aluminum was replaced by titanium in a fourth series, containing 2 atomic percent aluminum and 4 atomic percent titanium. Each of the four series was made up of a base alloy having no molybdenum, and three other alloys at 1.2, 3, and 5 atomic percent molybdenum. All other elements, including carbon, were kept to very low levels.

The influence of molybdenum additions to the alloys on the γ' weight fraction, chemical composition, lattice parameter, and morphology was determined by making measurements on the γ' phase that had been extracted from the two-phase alloys. The γ' weight fraction was determined by weighing, as well as by performing a mass balance on the aluminum. Other techniques of analyses used were atomic absorption analysis, x-ray diffraction and electron microscopy. Particularly useful were measurements made of the γ' solution temperature by means of the application of differential thermal analysis techniques to the alloys. Molybdenum significantly influences all of the important γ' characteristics measured. Future attempts to characterize the role of molybdenum in the nickel-base superalloys should therefore be extended to include its influence on the γ' phase. Additions of molybdenum to the nickel-base alloys significantly increase the solution temperature of the γ' phase in alloys hardened by both aluminum and aluminum plus titanium. Accompanying the γ' solution temperature increases are important increases in the weight fraction of the γ' phase. Molybdenum causes these γ' weight fraction increases by reducing the solubility limit of the γ phase for aluminum, thereby increasing the extent of the two phase $\gamma + \gamma'$ region. Significant amounts of molybdenum can dissolve in the γ' phase, where it substitutes for the chromium. The amount of molybdenum that dissolves in the γ' phase is markedly affected by the molybdenum content of the alloy, the titanium to aluminum ratio, and to a lesser extent, the exposure temperature. The molybdenum that dissolves in the γ' results in relatively large increases in the lattice parameter of the phase. The partitioning of molybdenum between the γ' and the γ phase controls the lattice parameter mismatch between the two phases. In this way molybdenum directly influences the γ' morphology. The shape of the γ' particles changes from spherical to cuboidal as the lattice parameter mismatch between the γ' and γ phase increases, both when the γ' lattice parameter is larger than that of the γ phase, and when the opposite is true. (Diss. Abstr. Int., B)

32402 THERMAL CONDUCTIVITY AND THERMAL SHOCK QUALITIES OF ZIRCONIA COATINGS ON THIN GAGE Ni–Mo–C METAL. Buckley, John D. (Langley Research Center, Hampton, Va.). Amer. Ceram. Soc. Bull.; 49: 588-91(7 Jun 1970).

Two zirconia coatings and a zirconia-nickel aluminide cermet coating were flame-sprayed and plasma-sprayed on Ni–Mo–C metal and then tested in a plasma jet to observe the effects of method application and/or thickness on the spalling tendency and insulating ability of the coatings. Results showed that flame-sprayed zirconia coatings had greater thermal shock resistance and resistance to heat transfer. Insulating ability of sprayed coatings proved to be linearly related to coating thickness. (auth)

32403 SOME OBSERVATIONS ON THE HARDENABILITY OF Ti–6Al–6V–2Sn. Hickey, Charles F. Jr.; Fopiano, Paul J. (Army Materials and Mechanics Research Center, Watertown, Mass.). Met. Trans.; 1: 1775-7(Jun 1970).

The hardenability of Ti–6Al–6V–2Sn alloy was investigated. Five bars were solution treated at 1600°F for 2 hr followed by a conventional Jominy end-quench. Two of the bars were reserved to be studied in the quenched condition, one was aged at 900°F, and the final two at 1150°F. The specimens were examined by hardness measurements, light and replica electron microscopy, and x-ray diffraction along the length of the bar. (G.M.C.)

32404 OMEGA PHASE EMBRITTLEMENT IN AGED Ti–V. Koul, M. K.; Breedis, J. F. (Massachusetts Inst. of Tech., Cambridge). Met. Trans.; 1: 1451-2(May 1970).

In Ti–V alloy specimens, aged at 250 to 350°C to produce ω, microscopic ductility was found while failure occurred with no macroscopic plastic strain. The apparent brittle behavior of ω-containing alloys was related to the large volume fraction and fine particle size of nondeformable precipitates which increased the rate of work hardening of the β-phase. (G.M.C.)

32405 SOME ASPECTS OF THE ANNEALING BEHAVIOR OF INDIUM. Dasarathy, Cuppam (British Steel Corp., Port Talbot, Eng.). Met. Trans.; 1: 1784-6(Jun 1970).

The effects of different heat treatments on the subsequent annealing behavior of deformed indium specimens are discussed. Indium was deformed in compression at −193°C and then one specimen was rapidly brought up to room temperature. The other specimen was kept at −193°C for about 24 hr and then slowly brought up to 20°C. (G.M.C.)

32406 SYSTEMATIC INVESTIGATION OF ELASTIC MODULI OF WC–Co ALLOYS. Doi, H.; Fujiwara, Y.; Miyake, K.; Oosawa, Y. (Mitsubishi Metal Mining Co., Ltd., Tokyo). Met. Trans.; 1: 1417-25(May 1970).

Measurements of Young's modulus, shear modulus, compression modulus, and Poisson's ratio on WC-(1 ~ 30) wt % Co alloys were carried out by dynamic resonance method. The effects of volume fraction of the WC phase, the carbon content, and the WC particle-size on the elastic moduli were investigated in some detail. The results showed that the various elastic moduli of the alloys depended solely on volume fractions of the constituent phases and they invariably fell within Hashin and Shtrikman's bounds. Moreover, the moduli were found to be approximated by Paul's strength-of-materials-type formulas. It is concluded that elastic behavior of the alloys can be essentially predicted on the basis of a simplified geometrical model of WC particles embedded in continuous cobalt matrix. (auth)

32407 INFLUENCE OF FILAMENT ORIENTATION AND FABRICATION VARIABLES ON THE PROPERTIES OF FIBER-REINFORCED METALS. Bhattacharyya, S.; Parikh, N. M. (IIT Research Inst., Chicago). Met. Trans.; 1: 1437-48(May 1970).

Continuous tungsten-filament, reinforced silver-matrix composites were prepared by electroplating, cold pressing, and hot pressing techniques followed by sintering, in the range of 2 to 33 vol % filaments. Orientation of the filaments with respect to the tensile axis was varied between 0 (parallel) and 90°. The properties determined were the ultimate tensile strength, 0.1% yield strength, proportional limit, elongation, and elastic modulus. The results indicated that the strength essentially followed the rule of mixtures. A misalignment exceeding 10 to 15° drastically reduced strength. A small misalignment of less than 10° not only did not lower the strength but greatly improved the ductility. Five different fracture paths were identified as a function of fiber orientation. Both ductile and brittle fracture were observed in the tungsten filaments. Many of the features of deformation and fracture were characterized by scanning electron microscopy. (auth)

32408 INTERNAL FRICTION OF COLD-WORKED Nb(Cb)–Al ALLOYS. Davenport, E.; Mah, G. (Arizona State Univ., Tempe). Met. Trans.; 1: 1452-4(May 1970).

The effect of cold-working on Nb-0.29 wt % Al alloy was investigated. Internal friction peaks, including oxygen cold-work peak and carbon, oxygen, and nitrogen Snoek peaks, were measured for the annealed and the cold-worked specimens. An exchange mechanism is proposed for a typical internal friction temperature profile before and after cold-work. (G.M.C.)

32409 ELECTROTRANSPORT OF CARBON, NITROGEN, AND OXYGEN IN ZIRCONIUM. Schmidt, F. A.; Carlson, O. N.; Swanson, C. E. Jr. (Ames Lab., Iowa). Met. Trans.; 1: 1371-4(May 1970).

The electrotransport velocities of carbon, nitrogen, and oxygen in zirconium were determined at 1625, 1700, and 1800°C. Diffusion coefficients and effective charges were calculated for each of these elements at the same temperatures. The diffusion coefficients in combination with the migration velocities were used to predict the mean concentration profile of zirconium rods after various time intervals. The removal of nitrogen and oxygen from zirconium was in good agreement with the predicted values after a 5 day run. In conjunction with this investigation the specific resistivity of β zirconium was measured and the solid solubility of carbon determined. (auth)

32410 THERMODYNAMICS OF DILUTE SOLUTIONS OF NEPTUNIUM IN LIQUID MAGNESIUM. Johnson, Irving; Heiberger, John J.; Fischer, Jack (Argonne National Lab., Ill.). Met. Trans.; 1: 1253-5(May 1970).

The activity coefficient of neptunium in liquid magnesium, at 650 and 700°C, was obtained from measurements of the distribution of neptunium between a 50 mole % $MgCl_2$-30 mole % NaCl-20 mole % KCl molten-salt solution and liquid Cd-Mg alloys. For dilute solutions of neptunium in liquid magnesium (0.04 at. % Np) the activity coefficient of neptunium was 23.3 at 650°C and 16.0 at 700°C. The solubility of neptunium in liquid magnesium was estimated to be 4.4 at. % (31 wt %) at 650°C. These data were used to estimate the activity coefficient of neptunium in liquid zinc and copper. (auth)

32411 HARDNESS AND GRAIN SIZE OF CONSOLIDATED FINE TUNGSTEN POWDER. Vashi, U. K. (Univ. of Maryland, College Park); Armstrong, R. W.; Zima, G. E. Met. Trans.; 1: 1769-71(Jun 1970).

The hardness of very fine-grained consolidated polycrystalline tungsten powder was determined as a function of grain size. (G.M.C.)

32412 FATIGUE LIFE AND TWINNING IN ALPHA-ZIRCONIUM. Warren, M. R.; Beevers, C. J. (Birmingham Univ., Eng.). Met. Trans.; 1: 1657-61 (Jun 1970).

Two grades of polycrystalline α-Zr containing ~0.003 and ~0.0775 wt ~ O were fatigued in tension-compression about a zero mean load at a frequency of 100 cps at room-temperature. A combined metallographic and microbeam x-ray pole-loci analysis revealed the presence of $\{10\bar{1}2\}$, $\{11\bar{2}1\}$, and $\{11\bar{2}2\}$ twins and $\{10\bar{1}0\}$ slip. In grains completely enclosed by surrounding material fatigue damage was found in association with $\{11\bar{2}1\}$ twins and very occasionally with $\{1\bar{1}22\}$ twins but not with $\{10\bar{1}2\}$ twins. A further quantitative interpretation showed that there was a critical resolved shear stress for $\{11\bar{2}1\}$ twinning of ~0.5 kg mm^{-2} in zirconium containing 0.003 wt % O. During observations confined to internal grains it was found that increasing grain size and decreasing oxygen content favored the formation of fatigue damage in association with these $\{11\bar{2}1\}$ twins. In external grains the fatigue damage was mainly in the form of edge cracks emanating from the specimen surface. The most appropriate criterion for the formation of damage in $\{11\bar{2}1\}$ twin-matrix interfaces appeared to be the attainment of a critical resolved shear stress in the $\{11\bar{2}1\}$ twinning plane in the $\langle 11\bar{2}6\rangle$ twinning direction. (auth)

32413 MULTIPLE NECKING OF TUNGSTEN FIBERS IN A BRASS-TUNGSTEN COMPOSITE. Vennett, Richard M.; Wolf, Stanley M.; Levitt, Albert P. (Army Materials and Mechanics Research Center, Watertown, Mass.). Met. Trans.; 1: 1569-75(Jun 1970).

A model composite system, brass-tungsten, was used to study the effect of multiple necking of metal fibers, strain rate, and fiber surface condition on the ductility and deformation behavior of uniaxial metal matrix composites. Low volume percent (<20 vol %) composites were made using brass (90 Cu-10 Zn) powders and tungsten wires. Tungsten wires contained in plastically deformed composites exhibited numerous necks per length of wire, with an average spacing between necks of 3 to 5 wire diameters. Composite ductility was shown to increase with decreasing multiple neck spacing and increasing percent reduction-in-area at the necks and was generally independent of strain rate. The multiple necking of tungsten wires in a brass matrix was found to result from local strain hardening of the brass matrix in the vicinity of each neck enabling the matrix to control composite deformation locally. Degrading the brass-tungsten interfacial bond by electropolishing the tungsten wires and coating them with graphite had no effect on the multiple necking phenomenon and composite ductility. (auth)

32414 STRAIN RATE DEPENDENT PLASTIC FLOW BEHAVIOR OF ZIRCONIUM AND ITS ALLOYS. Lee, D. (General Electric Research and Development Center, Schenectady, N. Y.). Met. Trans.; 1: 1607-16(Jun 1970).

The effect of strain rate ($10^{-5} \sim 10^{-1}$ min^{-1}) on the plastic flow behavior was examined by means of tension tests over a range of temperatures (RT ~ 500°C). The principal material examined was Zircaloy-2, and the others were iodide zirconium and binary alloys of Zr-0.1 % O and Zr-1.5 % Sn by weight. In Zircaloy-2, the behavior was characterized by a sudden increase of flow strength with decreasing strain rate; concurrently the ductility decreased. Other interrupted and hold time experiments showed that the process was essentially that of a strain rate-induced strengthening phenomenon, with several features which could be identified with the strain aging process. It was further shown that the critical range of strain rates and temperatures at which the anomalous behavior took place could be correlated with the minimum in the strain rate sensitivity of flow stress. A similar but less pronounced flow behavior was observed with pure zirconium and its binary alloys, but with no marked change in the tensile ductility. From these results, the role of oxygen and tin on the early stage of plastic flow behavior was discussed in terms of dislocation-impurity interaction mechanisms. It was however concluded that these elements are not directly responsible for the ductility loss at slow strain rate in Zircaloy-2. (auth)

32415 INTERACTIONS OF CURIUM SESQUIOXIDE WITH REFRACTORY METAL CERMET MATRICES. Donovan, J. A. (E. I. du Pont de Nemours and Co., Aiken, S. C.); Rankin, D. T.; Stuckey, J. E.; McDonell, W. R. Trans. Amer. Nucl. Soc.; 13: 83-4(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32416 NEW PLATINUM-BASE CAPSULE ALLOYS FOR SPACE ISOTOPIC HEAT SOURCES. Inouye, H.; Liu, C. T. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 84(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32417 HOT CRACKING IN WELDMENTS OF HAYNES ALLOY NO. 25. Tucker, P. A.; Cartmill, W. B. (Monsanto Research Corp., Miamisburg, Ohio). Trans. Amer. Nucl. Soc.; 13: 86(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32418 HELIUM PRESSURE AUTOREGULATION IN SEALED CAPSULES CONTAINING ALPHA-EMITTING MATERIALS. Davis, Monte V. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 13: 86-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32419 MATERIALS SURVEY FOR LMFBR STEAM GENERATORS AND INTERMEDIATE HEAT EXCHANGERS. Reuther, T. C. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 105-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32420 SELECTION AND TESTING OF MATERIALS FOR A ONCE-THROUGH, SODIUM-COOLED STEAM GENERATOR. Ray, W. E. (Westinghouse Electric Corp., Pittsburgh); Schrock, S. L.; Shiels, S. A.; Thomas, K. C. Trans. Amer. Nucl. Soc.; 13: 106-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32421 USE OF CROLOY 2¼ IN LMFBR STEAM GENERATORS. Domian, H. A.; Leyda, W. E.; Rowe, J. P. (Babcock and Wilcox Research Center, Alliance, Ohio). Trans. Amer. Nucl. Soc.; 13: 108(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32422 EXPERIENCE WITH A LOW-ALLOYED FERRITIC STEEL FOR HIGH-TEMPERATURE SODIUM SERVICE. Grosser, D.; Mausbeck, H.; Straubwasser, W. (Interatom, Cologne). Trans. Amer. Nucl. Soc.; 13: 109-10(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32423 STATUS OF MATERIALS FOR LMFBR VESSELS AND PIPING. Bush, S. H. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 116(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32424 GENERAL CONSIDERATIONS ON THE SELECTION OF STRUCTURAL MATERIALS FOR LIQUID METAL FAST BREEDER REACTOR PUMP APPLICATIONS. Drahos, F. R. (Borg-Warner Corp., Los Angeles). Trans. Amer. Nucl. Soc.; 13: 121(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32425 MATERIALS FOR SODIUM PUMP BEARINGS. Feduska, A.; Ray, W. E.; Shiels, S. A. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 13: 122-3 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32426 SHAFT SEAL MATERIALS FOR LMFBR SODIUM PUMPS. Atz, R. W. (Liquid Metal Engineering Center, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 124(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32427 INFLUENCE OF STRESS INTERACTION EFFECTS UPON PORE MOTION IN SOLIDS. Leiden, S. H.; Nichols, F. A. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 129-30(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32428 SIMULATION OF RADIATION-INDUCED MECHANICAL PROPERTY CHANGES BY SHOCK HARDENING. Ireland, D. R.; Kangilaski, M.; Wullaert, R. A. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc.; 13: 140-1(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32429 EFFECT OF FABRICATION VARIABLES ON THE BIAXIAL CREEP-RUPTURE PROPERTIES OF STAINLESS-STEEL TUBING. King, R. T.; Reimann, G. A. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 143(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32430 EFFECTS OF HEATING RATE AND PRESSURE ON EXPANSION OF ZIRCALOY TUBING DURING SUDDEN HEATING CONDITIONS. Emery, A. D.; Scott, D. B.; Stewart, J. R.

(Combustion Engineering, Inc., Windsor, Conn.). Trans. Amer. Nucl. Soc.; 13: 149(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32431 EFFECT OF OXYGEN ON THE COMPATIBILITY OF TANTALUM AND POTASSIUM. Klueh, R. L. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 162(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32432 THERMODYNAMIC ANALYSIS OF CARBON TRANSPORT IN LIQUID SODIUM. Hofer, G. (Siemens-Schuckertwerke AG, Erlangen, Ger.). Trans. Amer. Nucl. Soc.; 13: 167-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32433 THREE-DIMENSIONAL STRESS ANALYSIS PROBLEMS. Rashid, Y. R. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 183-4(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32434 SODIUM VAPOR DIFFUSION DATA. Peak, R. D. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 357-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32435 HYDROSTATIC PRESSURE DERIVATIVES OF THE SINGLE-CRYSTAL ELASTIC MODULI OF ZIRCONIUM. Fisher, E. S. (Argonne National Lab., Ill.); Manghnani, M. H.; Sokolowski, T. J. J. Appl. Phys.; 41: 2991-8(Jun 1970).

The adiabatic elastic moduli of single-crystal Zr vary linearly with hydrostatic pressures up to 4.7 kbar. The pressure derivatives are $dC_{11}/dP = 3.93$, $dC_{33}/dP = 5.49$, $dC_{44}/dP = -0.22$, $dC_{66}/dP = 0.26$, $dC_{12}/dP = 3.42$, and $dC_{13}/dP = 4.25$. The average high-temperature Gruneisen mode $\bar{\gamma}_H$ calculated from this data is in wide disagreement with that calculated from the volume thermal expansion coefficient. It is proposed that this disagreement arises because the negative dC_{44}/dP is caused by the change with pressure in the c/a ratio, rather than the volume change. (auth)

Structure and Phase Studies

Refer also to abstracts 31556 and 32929.

32436 (CEA-CONF-1502) THERMODYNAMIC STUDY OF Be–Al SYSTEM. Schaub, Bernard; Potard, Claude; Desre, Pierre (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [1969]. 8p. (In French). (CONF-690834-2). Dep. CFSTI (U. S. Sales Only).

From 1st International Conference on Calorimetry and Thermodynamics, Warsaw, Poland.

The thermodynamic properties of Be–Al alloys were studied at 1600°K over the whole range of concentration. The thermodynamic activities and the partial molar enthalpies were estimated and verified by some measurements made with the Knudsen effusion method. (auth) (France)

32437 (CEA-CONF-1503) THERMODYNAMICAL ACTIVITY OF CALCIUM IN LIQUID Sn–Ca AND Be–Ca ALLOYS. Potard, C.; Schaub, B. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires); Desre, P. (Grenoble Univ. (France)). [1969]. 11p. (In French). (CONF-690834-1). Dep. CFSTI (U. S. Sales Only).

From 1st International Conference on Calorimetry and Thermodynamics, Warsaw, Poland.

The thermodynamic activity of calcium in beryllium dilute alloys at 1300°C was determined by a partition method between two immiscible liquid phases, Be–Ca and Sn–Ca. The calcium activity in the tin phase was determined at this temperature by the isopiestic method. (auth) (France)

32438 (UCRL-19175) INITIAL STAGES OF ORDERING IN Ni_4Mo. Okamoto, Paul R. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar 1970. Contract W-7405-eng-48. 123p. Dep. CFSTI.

Thesis.

Transmission electron and field ion microscopy (FIM) techniques were used to study the nature of short range order (SRO) in as-quenched Ni_4Mo and the changes which occurred during the very initial stages of the transition to the long range ordered state. Field ion images of both as-quenched and alloys aged for very short times below 750°C showed a strong tendency for clustering of well defined groups of atoms about the ⟨420⟩ fcc poles. The effect was most pronounced in aged alloys where ordered regions were directly resolved in dark field electron micrographs. However, the effect was also observed in the alloys in which ordered regions were not directly resolved in transmission electron micrographs. The unique orientation dependence of the distribution of the well defined groups of atoms was evidence that the disordered alloy consisted of tiny regions possessing a layered type of atomic arrangement in which the Mo concentration was varying on the ⟨420⟩ matrix planes. The electron diffraction patterns of the as-quenched alloy exhibited both sharp $1\frac{1}{2}0$ SRO spots and very weak satellites near superlattice positions. However, the latter were detectable only in microphotometer traces and then only in diffraction patterns of certain favorable orientations. These satellites were not observed on ⟨002⟩ diffraction patterns as they were obscured by neighboring $1\frac{1}{2}0$ SRO spots. As ordering proceeded, the satellites eventually sharpened into superlattice reflections at the expense of the $1\frac{1}{2}0$ SRO spots. During the very early stages the satellites were streaked in the ⟨210⟩ directions of the fcc lattice; however, satellites which eventually developed into superlattice reflections corresponding to domains of a particular orientational variant were not initially streaked in the same ⟨210⟩ direction. An explanation for this is given in terms of a composition modulation normal to the {420} planes of the fcc lattice. A diffraction model based on this idea explains not only the $1\frac{1}{2}0$ SRO intensity maxima but also the presence of the weak satellites near superlattice positions. The model is also compatible with the FIM results and suggests that the bright well defined groups of atoms correspond to planes possessing a high Mo concentration. A physical basis for the diffraction model is given in terms of a recent spinodal approach to order–disorder transformations. The physical connection between the present results and the theoretical prediction of the Clapp–Moss theory of SRO is also discussed. (auth)

32439 COMPATIBILITY OF CARBIDE FUELS WITH METALLIC MATERIALS. 6. CHEMISTRY OF THE MULTICOMPONENT SYSTEM OF U–Pu CARBIDES WITH METALS. Akimoto, Yumi (Mitsubishi Metal Mining Co. Ltd., Omiya, Japan). Shin Kinzoku Kogyo; 14: 346-58(Dec 1969). (In Japanese).

The phase relations of Fe, Co, and Ni with C and the actinides are reported. Data are presented on Me–C, U–Me, Pu–Me, U–Me–C, Pu–Me–C, and U–Me_1–Me_2–C groups, eutectic point, solubility, thermodynamic quotient, lattice constant, crystal structure, stable temperature region, and the binary and ternary phase diagram of metastable compounds and intermetallic compounds were examined. These elements do not form stable carbides and dissolve the substantial quantity of carbon at high temperature. The diffusion rate of carbon in these elements is remarkably higher than that in ceramic compounds, such as UC. In Type 304 stainless steel in contact with carbon-saturated Na and Na with hyperstoichiometric UC, the relation between carbon content X and time t is represented by $X^2 = kt$. As the free energy difference between the system of reaction and the system of formation is not so large in the practical temperature region, the compatibility of iron group elements with U–PuC can tend in either way of propriety, governed by the composition of fuel and covering material. The compatibility of various stainless steels with U–PuC and that of Ni-base alloys with U–PuC are tabulated. The information on the buffering of UC with metal and compounds is also summarized. (NSA of Japan)

32440 INVESTIGATION BY SIMPLE THERMAL ANALYSIS OF STRUCTURE TRANSFORMATIONS IN METALS AND ALLOYS DURING FAST QUENCHING ($5 < V < 10{,}000$°C/SEC). Van Effenterre, P.; Cizeron, G. (Institut National des Sciences et Techniques Nucleaires, Saclay, France). Metaux (Corros.-Ind.); No. 533, 1-14(Jan 1970). (In French).

A thermal-analysis device for quenching was developed. Two possible applications are described with a few examples: decrease of the allotropic transformation points as a function of cooling rate (case of Zr, Ti, Fe and U); determination of the points Ms which can be observed only for notable quenching rates (case of type XC55 steel, alloys Zr–Cu with 1.6 and 2.4% Cu and Zr–Nb with 2.5% Nb). In the first case, an anomaly due to the U-chromel/alumel welding can be observed between the two transformations already known. The accuracy obtained for these various examples lies between ±2°C and ±20°C. (France)

32441 SODIUM-INDUCED FACETTING OF W(112). Chen, J. M. (Franklin Inst., Swarthmore, Pa.). Appl. Phys. Lett.; 16: 449-52(1 Jun 1970).

The effects of Na adsorption on an oxygen-covered W(112) surface are reported. It is found that if a W(112) surface is first covered with 1.5 monolayers of atomic oxygen and then covered with 0.8 monolayer of Na, and the surface is then heated in vacuum

to 650°K and higher, a series of surface structures is observed. These structures can only be explained by assuming facetting of the W(112) surface. (auth)

32442 NATURE OF BORON IN α-IRON. Hayashi, Y.; Sugeno, T. (Tokyo Univ.). Acta Met.; 18: 693-7(Jun 1970).

Internal friction measurements were carried out on iron-boron and iron-nickel-boron alloy specimens, in order to define the nature of the boron solid solution in α-iron. An internal friction peak corresponding to a small amount of boron in α-iron was observed. Referring to the lattice parameter measurements, and the diffusion experiments, it was concluded that boron atoms occupied both substitutional and interstitial positions. The concept of dissociative diffusion explained well the diffusion mechanism of boron in α-iron. The relaxation time of the jump of an interstitial boron atom was shown to be 10^{-13} exp (13000/RT) sec. (auth)

32443 THERMAL DEPINNING OF DISLOCATIONS. Inagaki, H. (Technische Hochschule, Aachen); Hultgren, F.; Luecke, K. Acta Met.; 18: 713-21(Jun 1970).

The ultrasonic attenuation of copper single-crystals was measured for the well annealed state, after γ-irradiation and after different subsequent annealing treatments. The attenuation, decreased by the radiation, increased during the annealing treatments indicating a disappearance of the radiation induced pinning points. The observed decrement vs. frequency curves exhibited a maximum, from which the mean distance between neighboring pinning points could be computed with the help of the Granato-Lücke-theory of dislocation resonance. The plot of this distance vs. the annealing temperature showed two clearly defined depinning stages, one at about 120°C, the other at about 350 to 400°C. The possible mechanisms of depinning are discussed. (auth)

32444 PHASE TRANSFORMATIONS IN BETA ISOMORPHOUS TITANIUM ALLOYS. Koul, M. K.; Breedis, J. F. (Massachusetts Inst. of Tech., Cambridge). Acta Met.; 18: 579-88(Jun 1970).

Formation of the omega and alpha phases on quenching and aging and of martensite under an applied stress was studied in binary, beta isomorphous titanium alloys containing molybdenum, niobium, and vanadium. Thermodynamic calculations using the regular solution approximation revealed that the beta phase exhibited a tendency for phase separation. Such compositional fluctuations in the beta phase could lead to an increase in the driving force for alpha phase formation in titanium–vanadium but were not associated with omega formation. Stress-induced martensite formed in molybdenum- and vanadium-containing alloys was found to be hexagonal close-packed, as expected from thermodynamic considerations. (auth)

32445 STRUCTURAL CHANGES DURING ISOTHERMAL ANNEALING OF THE QUENCHED Ni_3Mo ALLOY. I. Yamamoto, Masahiko (Osaka Univ.); Nenno, Soji; Saburi, Toshio; Mizutani, Yasumasa. Trans. Jap. Inst. Metals; 11: 120-6(Mar 1970).

Transmission electron and optical microscopic observations were made on the Ni–24.4 at.% Mo alloy (nearly stoichiometric Ni_3Mo) to clarify the decomposition process during isothermal annealing after quenching from the α-region (face-centered cubic structure). It is found that the alloy quenched from the α-region shows a short-range order similar to that found in the Ni_4Mo alloy, and when annealed isothermally below the peritectoid temperature, γ (Ni_3Mo) does not precipitate directly from the short-range-ordered matrix, but a meta-stable phase Ni_2Mo (Pt_2Mo type superlattice) does. These precipitates of Ni_2Mo are lenticular in shape and grow to plates. The habit plane of the plate-shaped Ni_2Mo precipitates is of the $\{110\}_\alpha$ type. With increase in annealing time, β (Ni_4Mo) precipitates in the matrix, and Ni_2Mo and β coexist. On the other hand, γ nucleates predominantly at grain boundaries of α and grows. When annealed for a longer time, γ predominates by consuming the pre-existing Ni_2Mo and β. The orientation relationships of each of precipitates (Ni_2Mo, γ and β) with the matrix were determined. (auth)

32446 DISCONTINUOUS PRECIPITATION OF SOLUTION-TREATED Nb–40 Zr–10 Ti SUPERCONDUCTING ALLOY. Kitada, Masahiro; Doi, Toshio (Hitachi Ltd., Tokyo). J. Jap. Inst. Metals; 34: 361-5(Apr 1970). (In Japanese).

The discontinuous precipitation behavior of solution-treated Nb–40 Zr–10 Ti alloy was investigated by means of optical and electron microscopy and hardness measurements. Several types of discontinuous precipitation were observed morphologically. The $\langle 1\bar{1}0\rangle$ direction of β' was nearly parallel to the $\langle 1\bar{1}0\rangle$ direction of the β''' phase. The rate of the $\beta \rightarrow \beta' + \beta'''$ reaction (lamellar type) of the specimen aged at 620 to 800°C decreased with increasing aging temperature. The interlamellar spacing of the $\beta' + \beta'''$ structure aged at 620 to 825°C increased linearly with the aging temperature. The hardness (H_{MV}) in the discontinuous precipitated region (about 200) was lower than that of the continuous precipitated region (maximum : 350). (auth)

32447 COMMENTS ON OBSERVED STREAKING IN FIELD-ION MICROSCOPY IMAGES OF TUNGSTEN–10 AT PERCENT RHENIUM. Clum, J. A.; Moazed, K. L. (Ohio State Univ., Columbus). J. Less-Common Metals; 21: 203-4(Jun 1970).

In field-ion microscopic studies of thermomechanically treated tungsten and W–10 at.% Re it was found that the occurrence of streak defects in field-ion images which were due to thermomechanical treatments was masked by streaks induced during specimen preparation. A most significant correlation was found between streaking and the technique of electropolishing. (G.M.C.)

32448 DYSPROSIUM–IRON SYSTEM: STRUCTURAL AND MAGNETIC PROPERTIES OF DYSPROSIUM–IRON COMPOUNDS. Van Der Goot, A. S.; Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals; 21: 151-7 (Jun 1970).

The Dy–Fe system was investigated over the whole concentration range by means of x-ray diffraction, thermoanalysis, and metallography. The constitutional diagram is given. Four intermetallic compounds were observed: $DyFe_2$, $DyFe_3$, Dy_6Fe_{23}, and Dy_2Fe_{17}; the structure type and the lattice parameters are given. Measurements of the bulk magnetization were performed on all Dy–Fe compounds between 4.2 and 1200°K. Their Curie points decreased with increasing iron concentration. The compounds $DyFe_3$ and Dy_6Fe_{23} showed a compensation point. (auth)

32449 DISCONTINUOUS PRECIPITATION OF COLD-WORKED Nb–40 Zr–10 Ti SUPERCONDUCTING ALLOY. Kitada, Masahiro; Doi, Toshio (Hitachi Ltd., Tokyo). J. Jap. Inst. Metals; 34: 365-9(Apr 1970). (In Japanese).

Discontinuous precipitation of a cold worked Nb–40 Zr–10 Ti alloy was investigated by means of transmission electron microscopy, and the other properties related to the discontinuous precipitation were also examined. Discontinuous precipitation occurred in the cold worked specimen. The $\langle 1\bar{1}0\rangle$ direction of the β' phase was nearly parallel to the $\langle 1\bar{1}0\rangle$ direction of the β''' phase. The $\beta' + \beta'''$ interlamellar spacing in the cold worked specimen was about $1/_{10}$ (0.1 to 0.2 μ, aging at 700°C) of the solution-treated one. Discontinuous precipitation occurred initially at dislocation sites. The $\beta' + \beta'''$ fine lamella in the cold worked specimen spheroidized and then coarsened to a stable size. The relationship between the crystal orientations of the β phase and the coarsened $\beta' + \beta'''$ phase was the same as in the case of the lamellar structure. On the critical current vs aging time curve, two peaks were observed. On the hardness vs aging time curve, however only one peak was observed, and this peak corresponded to the first peak of the critical current. (auth)

32450 PRECIPITATION AND SUPERCONDUCTING PROPERTIES OF Nb–40 Zr–10 Ti ALLOY. Kitada, Masahiro; Doi, Toshio (Hitachi Ltd., Tokyo). J. Jap. Inst. Metals; 34: 369-74(Apr 1970). (In Japanese).

The precipitation process of the Nb–40 Zr–10 Ti alloy aged at 400 to 500°C was investigated by means of hardness measurements, and optical and electron microscopy. The results were discussed in relation to superconducting properties such as the critical current density vs applied transverse magnetic field and the transition temperature. In this alloy aged at about 500°C after a solution treatment, the β'' phase first precipitated continuously within β grains and then the $\alpha + \beta''$ phases began discontinuously to precipitate in the grain boundary to expand into the region, in which the continuous precipitation had already occurred. The $\alpha + \beta''$ lamella was a finally stable structure. From the result of an EPMA test, the Nb content in the continuously precipitated region were found to be relatively lower than those of the discontinuously precipitated region. The Vickers hardness in the $\alpha + \beta''$ lamella was about 230, which corresponded to $^3/_5$ of the hardness in the continuously precipitated region. Both the continuous and discontinuous precipitations were promoted by cold working. The critical current density increased with increasing aging time. This result may be thought to be mainly due to the precipitation of the β'' phase. The superconducting transition temperature increased with increasing aging time. (auth)

32451 IDENTIFICATION OF PRECIPITATES IN VTiNb ALLOYS USING ELECTRON MICROSCOPY, MICROPROBE INVESTIGATIONS, AND X-RAY FINE STRUCTURE ANALYSIS. Heesen, Doris; Matucha, Karl-Heinz; Rudolph, Guenter (Metallgesellschaft AG, Frankfurt am Main). Prakt. Metallog.; 7: 225-34(May 1970). (In German and English).

Although in many cases it is possible to identify precipitates using electron diffraction by thin foils, this relatively inaccurate method of structure determination can be insufficient for the un-

equivocal identification of precipitates in complicated alloys containing several types of precipitates. A technique is described which utilizes electron microscopy, microprobe investigations and x-ray fine structure analysis on extraction replicas of the precipitates and yields information about the precipitates such as size, distribution, structure, chemical composition, crystal structure, and accurate lattice constant determination (x-ray analysis). The technique was used successfully on VTi 3 Nb 15 alloys. (auth)

32452 INVERTED V SEGREGATION IN KILLED STEEL INGOTS (STUDY ON THE SOLIDIFICATION AND SEGREGATION OF STEEL INGOTS USING ACTIVABLE TRACERS-I). Narita, Kiichi; Taniguchi, Masayuki; Kujime, Akira (Kobe Steel, Ltd., Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 235-7 (1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Several experiments were conducted with test ingots of commercial size in order to clarify the nature and the mechanism of formation of inverted V segregates in killed steel ingots. A small amount of Mn, Cu, and Au was used in these experiments as activable tracers to follow the behavior of solute elements in the segregated zone. Liquid steel which had the nominal composition of carbon steel and contained the tracers was poured into the 3 to 20 ton ingot molds and solidified. Samples in the form of thin plates were taken from various sections of these ingots and irradiated by thermal neutrons of a nuclear reactor, TRIGA-Mark II. After suitable decay periods had elapsed, autoradiographs which showed the distribution of $Mn(^{56}Mn)$, $Cu(^{64}Cu)$, and $Au(^{198}Au)$ in the surfaces of samples, were taken on the x-ray film. The autoradiographs revealed the degree of solute segregation as well as the solidification structure of the ingots. In these experiments many samples for the autoradiographic observation were taken especially from the region where inverted V segregates occur frequently. Then, the characteristics of solidification structure and solute segregation were investigated in detail inside and outside the segregates. (auth)

32453 MIXED CRYSTAL SERIES $NbAl_3$–$NbGa_3$. Girgis, K. (Institut fuer Kristallographie und Petrographie, Zurich). Naturwissenschaften; 57: 193(Apr 1970). (In German).

Lattice constants are given for $NbAl_3$, $NbGa_3$, and mixed-crystal samples prepared from the pure metals. (M.C.G.)

32454 ACOUSTIC EMISSIONS GENERATED DURING PHASE TRANSFORMATIONS IN METALS AND ALLOYS. Liptai, R. G. (Argonne National Lab., Ill.); Dunegan, H. L.; Tatro, C. A. Int. J. Nondestruct. Test.; 1: 213-21(Oct 1969).

Phase transformations in metals and alloys usually are grouped in one of two general categories: nucleation-and-growth, or martensitic (shear) transformations. The choice depends on the atomic mechanism involved in the transformation. Unlike the nucleation-and-growth process, which involves thermal activation and diffusion, martensitic transformations are diffusionless reactions characterized by cooperative movements of atoms through small distances relative to neighboring atoms. Acoustic emissions are the stress waves or lattice vibrations that are generated during these shear-like reactions. Emission analysis has been used for material evaluation and for characterization of martensitic transformations. Experiments were conducted using binary alloys of gold-47.5 at. % cadmium and indium-22 at. % thallium, and in pure cobalt and plutonium. The use of emission analysis and the experimental results are discussed. Metallurgical processes other than martensitic phase transformations can generate acoustic emissions. Emission analysis of these processes for material evaluation will also be discussed. An electrosonic technique is used to detect acoustic emission in the frequency range between 90 to 200 kHz. The electronic equipment (for example, lead-zirconate-titanate sensing transducer, amplification and recording apparatus) and the experimental techniques will be described. (auth)

32455 EFFECTS OF SELECTED MINOR ALLOYING ADDITIONS ON THE STRUCTURE AND DEFORMATION CHARACTERISTICS OF BERYLLIUM. Dooley III, George Joseph. Corvallis, Oreg.; Oregon State Univ. (1969). 189p. Thesis.

Solid solution alloying was employed in an attempt to produce a relatively ductile form of beryllium. If the c/a ratio could be significantly altered, it was felt new or different slip systems could be activated. The following elements were selected on the basis of atomic size, melting point, crystal structure and density for adding to beryllium in amounts of 0.5, 1.0, 2.0, 3.0, 4.0, 5.0 and 10.0 atomic percentages: boron, manganese, and titanium. All samples were non-consumable arc melted, machined and sectioned for wet chemical spectrographic, x-ray diffraction and metallographic analysis as well as for mechanical (compression) testing. These tests showed all alloy samples exceeded the solubility limits in each respective system. $Be_{4-5}B$, Be_8Mn and $Be_{12}Ti$ were identified as the second phases in the individual systems. Beryllium–boron alloys exhibited an eutectic or peritectic reaction and the eutectic composition in the beryllium–manganese system was established at 22.0 weight percent manganese. The samples Be/0.5B, Be/1.0Mn and Be/0.5Ti gave yield strengths of 47,200 psi, 56,600 psi and 81,250 psi respectively in compression testing. These same specimens yielded work hardening rates of 1.07×10^6psi, 1.3×10^6 psi and 1.52×10^6 psi respectively. Long wide twins in pure beryllium were accompanied by large amounts of cross-slip. The boron sample displayed long wide twins and also very short narrow twins, no cross-slip and extensive areas with microcracks present. Shorter and narrower twins characterize the manganese specimens. The beryllium–titanium alloys exhibited extremely small twins emanating from particles of second phase $Be_{12}Ti$; however, the majority of the twins in this system are long, extremely narrow and are seen to be internally constricted along the length of the twin. These constrictions have been ascribed to a strain relief process which further prevented the twin from growing parallel to its shorter dimension. The near total absence of cross-slip in the three alloy systems was attributed to a lessening of the stacking fault energy as a result of increasing the solute concentration. The drop in the stacking fault energy decreases the probability for cross-slip, makes extensive deformation difficult and explains higher yield strengths and work hardening rates. Evidence presented suggests slip occurs prior to gross twin propagation. The relationship between twinning shear and twin shape suggests for the beryllium–titanium alloys twinning on higher order planes (e.g., $\{11\bar{2}1\}$ or $\{11\bar{2}2\}$) rather than the $\{10\bar{1}2\}$ twinning normally observed. (Diss. Abstr. Int., B)

32456 CLUSTERING OF Zr AND N IN Nb. Mosher, D. (Univ. of Colorado, Boulder); Dollins, C.; Wert, C. Acta Met.; 18: 797-803(Jul 1970).

Relaxation peaks associated with two interaction clusters involving Zr and N dissolved in Nb were identified on the basis of the change in their heights with changes in alloy composition. One relaxation accompanies the stress-induced rearrangement of single nitrogen atoms among the interstices adjacent to single zirconium atoms; the second is the result of a similar process relative to zirconium pairs. Interstitial mobilities during these relaxations were deduced from the temperature dependence of their respective relaxation times. Variation in the concentrations of solute clusters brought about by changes in temperature indicated positive binding enthalpies relative to isolated Zr and N atoms in the free lattice. Evaluation of these enthalpies was made possible by accurate determinations of the temperature dependence of solute cluster concentrations. (auth)

32457 COMMENTS ON STACKING FAULT ENERGIES OF SOME CLOSE-PACKED HEXAGONAL METALS. Dobson, P. S.; Smallman, R. E. (Univ. of Birmingham, Eng.). Scr. Met.; 4: 345-6(May 1970).

Comments are given on a paper by Sastry, Prasad, and Vasu [Scr. Met., 3: 927 (1969)] concerning the stacking fault energies of magnesium, zinc, and cadmium. (G.M.C.)

32458 REPLY TO COMMENTS ON STACKING FAULT ENERGIES OF CLOSE-PACKED HEXAGONAL METALS. Sastry, D. H.; Prasad, Y. V. R. K.; Vasu, K. I. (Indian Inst. of Science, Bangalore). Scr. Met.; 4: 347-8(May 1970).

A rebuttal is given to Dobson and Smallman [Scr. Met., 4: 345-6 (1970)] concerning their comments on a paper dealing with the stacking fault energies of magnesium, zinc, and cadmium [Scr. Met., 3: 927 (1969)]. (G.M.C.)

32459 V–Ni SYSTEM. Stevens, E. R.; Carlson, O. N. (Ames Lab., Iowa). Met. Trans.; 1: 1267-71(May 1970).

The vanadium-rich portion of the V–Ni system was investigated by thermal analysis, microscopic examination, and x-ray diffraction studies and a phase diagram is proposed. The vanadium solvus was found to exhibit a marked temperature dependence increasing from 6.8 at. % Ni at 800°C to 24.0 at. % Ni at 1280°C. A compound having a substituted V_3Ni (A15) type structure was shown to occur at the substoichiometric composition of 22 to 23 at. % Ni. It forms peritectoidally at 900°C with an enthalpy of formation of 1595 cal per mole. (auth)

32460 SURFACE DISTORTIONS IN TWINNED NIOBIUM CRYSTALS. Wasilewski, Roman J. (Battelle Memorial Inst., Columbus, Ohio). Met. Trans.; 1: 1617-22(Jun 1970).

The surface distortions resulting from the formation of mechanical twins in niobium single crystals were more complex than the simple tilts predicted from the twinning shear. Tilt angles observed varied from zero to well in excess of the con-

ventionally predicted values. In addition, the shear offset was not limited to the twinned lamella, but was generally also observed in the adjacent matrix. These observations suggest that macroscopic shear need not be necessary in the initial twin formation. It is suggested that such shear offset, when present, is associated with the simultaneous occurrence of slip, and that the shear probably takes place after the initial twin formation, during the subsequent transverse twin growth. Observed slip markings, and the energy associated with the initial twin formation, are also briefly discussed. (auth)

32461 DISLOCATION DIFFUSION IN NIOBIUM SINGLE CRYSTALS. Reuther, T. C.; Achter, M. R. (Naval Research Lab., Washington, D. C.). Met. Trans.; 1: 1777-9(Jun 1970).

The effect of defect structure on self diffusion in monocrystalline niobium in the as-grown and polygonized conditions was examined. (G.M.C.)

32462 DISLOCATION DAMAGE IN TANTALUM AFTER CYCLIC LOADING. Komem, Y.; Brandon, D. G. (Technion-Israel Inst. of Tech., Haifa). Met. Trans.; 1: 1663-8(Jun 1970).

The dislocation distribution in tantalum foil after fatigue testing in the region of the yield point was determined quantitatively using thin film electron microscopy. Changes in the measured microstructural parameters as a function of stress level, test temperature, and number of loading cycles were related to a microscopic model of the fatigue process. The model led to a consistent criterion for fatigue failure based on the gradual growth of impenetrable subboundary groups of immobile dislocations. (auth)

32463 PRECIPITATION KINETICS IN Nb(Cb)–N ALLOYS. Hennessy, D.; Altstetter, C. (Univ. of Illinois, Urbana). Met. Trans.; 1: 1185-8(May 1970).

Niobium wires were doped with 0.2 wt % N and then directly aged at temperatures from 300 to 650°C for various lengths of time. Metallographic examination revealed a product phase at subgrain boundaries which exhibited linear growth for each reaction temperature. An activation energy of 5.6 kcal per mole for the process was obtained. Although the reaction was thought to be discontinuous precipitation, additional information from electron microscopy, internal friction, and hardness measurements indicated that both precipitation and a coarsening process were occurring simultaneously. (auth)

32464 DISLOCATION STRUCTURES IN SINGLE-CRYSTAL TUNGSTEN AND TUNGSTEN ALLOYS. Stephens, Joseph R. (Lewis Research Center, Cleveland). Met. Trans.; 1: 1293-1301 (May 1970).

Deformation of tungsten single crystals as a function of strain, temperature, and alloying was studied by transmission electron microscopy. Single crystals oriented for $(\bar{1}01)[111]$ slip were grown by electron beam zone refining. Compression specimens of tungsten, W-1 and 3 % Re and W-1 and 3 % Ta were deformed to 2 % strain at 150, 300, and 590°K (0.04, 0.08, and 0.16 T_m). Specimens were also strained to 0.5 and 5.0 % strain at 300°K. Transmission microscopy revealed that the dislocation substructures in single-crystal tungsten were similar to substructures in other refractory metals when compared on a homologous temperature basis. At temperatures greater than 0.1 T_m, the substructure was characterized primarily by edge dipoles. At temperatures less than 0.1 T_m, long screw dislocations lying parallel to the primary [111] slip direction characterized the substructure. Rhenium additions to tungsten promoted formation of edge dipoles at temperatures of 300 and 150°K and increased dislocation density at all three temperatures. In addition, dislocations consistent with $(1\bar{1}2)[\bar{1}11]$ slip were observed in the W–Re single crystals after deformation at 150°K. Tantalum additions had a lesser effect on the dislocation substructure compared to rhenium additions. The W-1 and 3 % Ta alloys exhibited higher dislocation densities than unalloyed tungsten after similar strains and, at 150°K, W-3 % Ta contained a few dislocations consistent with $(1\bar{1}2)[\bar{1}11]$ slip. It is concluded that the reduction in ductile-brittle transition temperature of polycrystalline tungsten containing dilute rhenium additions, 1 to 5 %, can be attributed to an increase in dislocation mobility at temperatures less than 0.1 T_m. (auth)

32465 DEVELOPMENT OF ROLLING TEXTURE IN A Nb (Cb)–40 PCT V ALLOY. Vandermeer, R. A.; Ogle, J. C. (Oak Ridge National Lab., Tenn.). Met. Trans.; 1: 1461-3(May 1970).

The effect of composition on texture in rolled polycrystalline bcc niobium was investigated. The addition of 40 % V to pure niobium had negligible effect on the center rolling texture development of the metal. Under the same conditions in which a surface shear texture was developed in pure niobium, none was found in the alloy. (G.M.C.)

32466 CORRELATION OF STRUCTURE AND SUPERCONDUCTING PROPERTIES IN Nb(Cb)–Ti QUATERNARY ALLOYS. Ricketts, R. L.; Courtney, T. H.; Shepard, L. A.; Wulff, J. (Massachusetts Inst. of Tech., Cambridge). Met. Trans.; 1: 1537-44(Jun 1970).

The aging behavior of a Nb–Ti alloy containing 60 wt % Ti and small additions of oxygen and erbium or scandium was characterized and related to superconducting properties. The ternary and quaternary alloys were cold reduced and aged for various times at temperatures between 250 and 1000°C. Omega and α phase transformations and oxide precipitation processes were followed by lattice parameter, diffraction intensity, resistivity, and metallographic studies, and correlated with superconducting critical magnetic field and critical current density measurements. The optimum 1 hr aging temperatures for producing ω and α phase precipitation were found to be 400 and 500°C, respectively. Aging at 1000°C produced only oxide precipitation. It was found that oxygen, erbium, and scandium stabilize the α phase but had little effect on ω precipitation. The ω phase proved the most effective fluxoid pinning precipitate. The fine scale dispersoid provided an extremely high number density of pinning sites. (auth)

32467 STACKING FAULT ENERGIES OF SOME CLOSE-PACKED HEXAGONAL METALS. Sastry, D. H.; Prasad, Y. V. R. K.; Vasu, K. I. (Indian Inst. of Science, Bangalore). Scr. Met.; 3: 927-8(Dec 1969).

Data are presented on the stacking fault energies of Mg, Cd, and Zn. The energies were calculated from the constriction energy using a formula relating the equilibrium separation between the partial dislocations. (J.R.D.)

Radiation Effects

Refer also to abstracts 31588, 31599, 32519, and 33233.

32468 (BAW–10006(Rev.1)) REACTOR VESSEL MATERIAL SURVEILLANCE PROGRAM. (Babcock and Wilcox Co., Lynchburg, Va. Nuclear Power Generation Dept.). May 1970. 34p. Dep. CFSTI.

The reactor vessel material surveillance program is designed to provide information on reactor vessel material nil-ductility transition temperature (NDTT) changes caused by neutron irradiation. The program is for the 850-MW(e) class of reactors of similar design and power level. Data obtained from all of the vessels surveyed in the program can be integrated and applied to any vessel so long as the fabrication procedures and the designs are comparable. The program is applicable to all future plants of similar design if the geometry and the type of vessels used are the same and if the pressure vessel steel treatment is the same. (J.R.D.)

32469 (JUL–642–FN) DEFECT PRODUCTION AND RECOVERY IN LOW-TEMPERATURE ELECTRON IRRADIATION OF TANTALUM. Meissner, Dieter (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerper- und Neutronenphysik). Feb 1970. 66p. (In German). Dep. CFSTI (U. S. Sales Only).

High purity tantalum foils were irradiated with electrons at 5°K. The synthesis of defects and their thermal recovery up to 500°K were investigated by measurement of the electrical resistance. In irradiation with 3.0-MeV electrons up to doses of 3.5×10^{19} e/cm^2 the specific resistance increases up to about 1.4×10^{-6} Ω cm. The observed decrease of the damage was analyzed by subthreshold irradiations with 1.2 MeV electrons. The saturation phenomenon in the defect production was determined to 85% of subthreshold collision processes and only to 15% on spontaneous recombination processes. The effective cross-section for subthreshold recombinations, which especially affect neighboring Frenkel pairs, is 90,000 b and the spontaneous recombination volume is 20 atomic volumes. These results were confirmed by radiation doping experiments. The production of Frenkel defects in electron irradiation appears to be dependent on the orientation of the sample to the electron beam. The defects produced were recovered by isochronous tempering programs. A recovery model applied for the interpretation showed that all observed recovery stages are ascribable to self-failures. The recovery range of Stage I is below 20°K. The neighboring pairs are annealed for the most part up to 12°K. Above 40°K agglomerates of interstitial atoms were found. Vacancy mobility and dose displacement of the higher stages could not be detected. The interstitial atoms seem to be at a greater distance from their vacancies than in the cubic face-centered metals Al, Cu, and Pt. Direct transformations by subthreshold collisions could be detected, but only in those cases in which the distance from interstitial atom to vacancy was re-

duced and the distance of interstitial atoms in a cluster was increased. These results were confirmed also by radiation doping studies. (tr-auth)

32470 (ORNL-4526, pp 17-24) DISLOCATIONS AND RADIATION EFFECTS ON PLASTIC DEFORMATION. (Oak Ridge National Lab., Tenn.).

COPPER—deformation of crystal plates of, x-ray topographic study of tensile
—radioinduced dislocation pinning in crystals of, fast neutron
IRON ALLOYS & SYSTEMS—Fe-base-N, hardening of, radiation-anneal
NEUTRONS—effects on deformation properties of niobium
NEUTRONS, FAST—effects on dislocation pinning in copper
NIOBIUM—hardening of, effects of radiation on
URANIUM ALLOYS & SYSTEMS—Nb-U-base-Zr, internal friction spectrum of, effects of heat treatment on (D.L.C.)

32471 (UJV-2314-M) EFFECTS OF CERTAIN METALLURGICAL FACTORS ON RADIATION SENSITIVITY OF Mn-Ni-Mo STEEL PRESSURE VESSEL A-2. Cervasek, J.; Juricka, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Mar 1970. 57p. (In Czech). Dep. CFSTI (U. S. Sales Only).

The radiation sensitivity of four variants of Mn-Ni-Mo steel were compared. Among particular variants the differences were in chemical composition, kind of working, killing, and heat treatment. The radiation sensitivity was compared in view of the changes of mechanical properties, transition temperature, and ability to recover. The experiments showed not only different absolute changes but also relative ones in particular variants according to neutron dose. The comparison showed that at 10^{19}n/cm^2 (E > 1 MeV), the heat with higher content of C, Mn, Cr and killed with Nb, Zr, Al, V is less sensitive than the original heat killed with Nb, Ti, Al. The comparison also showed that steel in the normalized state has better qualities than quenched and tempered steel. (auth)

32472 INTERACTION OF NEUTRON AND THERMAL ENVIRONMENTAL FACTORS IN THE EMBRITTLEMENT OF SELECTED STRUCTURAL ALLOYS FOR ADVANCED REACTOR APPLICATION. Serpan, Charles Z. Jr.; Watson, Henry E.; Hawthorne, J. Russell (Naval Research Lab., Washington, D. C.). Nucl. Eng. Design; 11: 368-80(Apr 1970).

An experimental irradiation was conducted in the Big Rock Point Reactor (BRPR) to obtain comparisons of the individual irradiation response of five structural steels of current and potential application for nuclear reactor pressure vessels. The steels included A302-B, A543, A517-E, 7-½% Ni-Cr-Mo, and 12Ni-5Cr-3Mo (2 heats) in plate form. The temperature and duration of the irradiation exposure were 585°F and 9,726 hr respectively. The exposure was conducted under typical boiling water reactor conditions. Charpy-V (C_v) specimens of the five steels were evaluated in the as-irradiated condition and in the postirradiation annealed condition. Non-irradiated C_v specimens aged at 575°F for 9,726 hr were also evaluated. Additional non-irradiated C_v specimens were aged at 700 and 800°F for 168 hr as a reference for evaluating the postirradiation annealed specimens. Postirradiation C_v 30 ft-lb transition temperatures of all materials were at or below boiling water temperatures; individual transition temperature increases ranged from 95 to 205°F for fluences of 4.7 to 7.4 × 10^{19} n/cm^2 > 1MeV. Postirradiation annealing was found to be generally less effective with higher initial yield strength steels. The effect of long-term 575°F aging on notch ductility behavior was negligible for the lower yield strength steels but produced transition temperature increases of 55 to 150°F with the higher yield strength steels. Aging of unirradiated C_v specimens for 168 hr at 700 and 800°F resulted in transition temperature increases for most steels that were very close to the transition temperatures after postirradiation annealing. Tensile properties were found altered only slightly by the irradiation exposure. Small increases in yield and tensile strength were accompanied by small decreases in tensile ductility. In terms of postirradiation strength and ductility, the three lower yield strength steels appear to be more acceptable for application in reactor pressure vessels than the two higher strength steels. The data suggest that the 12-5-3 maraging steel is not suited for long-term elevated temperature reactor service due to thermal instability. (auth)

32473 MECHANICAL PROPERTIES BEHAVIOR OF NEUTRON IRRADIATED 12Ni-5Cr-3Mo MARAGING STEEL PLATE AND COMPANION WELD METAL. Gray, Robert A. Jr.; Hawthorne, J. Russell (Naval Research Lab., Washington, D. C.). Nucl. Eng. Design; 11: 381-92(Apr 1970).

Charpy-V notch ductility and tensile properties changes in neutron irradiated 12Ni-5Cr-3Mo maraging steel were evaluated following low (<250°F) and elevated temperature (550 to 740°F) exposure. The study was performed with 1-in. thick plate material (six heats) aged at 900°F for 2 and 20 hr to nominal yield strengths of 160 and 180 ksi respectively. Long term thermal stability of both heat treatment conditions was investigated for the conditions of irradiation. The <250°F and 550°F irradiation performance of matching (12-5-3) and mismatching (17Ni-2Co-3Mo) TIG weld deposits maraged to 180 ksi yield strength was also assessed in this study. General properties changes of the 12-5-3 maraging steel plate and companion weld metals were found to be rather small with <250°F exposures, indicating good resistance to neutron-induced embrittlement. However, a marked deterioration of notch ductility properties with long term exposure at elevated temperature was revealed and traced to a non-nuclear thermal instability. The observed instability is believed to be a continuation of aging processes at temperatures well below the initial maraging temperature. Extended time-at-temperature treatments indicated that service above 550°F may produce sufficient properties changes for failure by low energy tear. Aging treatments of 1900 to 3300 hours duration increased the yield and tensile strengths of the 12-5-3 alloy by as much as 52.0 and 53.3 ksi respectively while not altering appreciably percent elongation and reduction of area values. (auth)

32474 MASUREMENT OF DEPTH-DOSE DISTRIBUTION IN ELECTRON IRRADIATED MATERIALS. Davies, John M.; McQue, Bernard (Army Natick Labs., Natick, Mass.). Int. J. Appl. Radiat. Isotop.; 21: 283-304(May 1970).

The dose distribution in cellophane and aluminum irradiated with 0.5 to 1 MeV electrons was determined by observing the changes in optical transmission of blue dyed cellophane interspersed between thin layers of the materials. The effect of dye depletion with exposure was taken into account in two ways: (1) a graphical method; (2) a calculation of the conversion of the dye molecule to a transparent form in terms of its cross section. In cellophane the depth of maximum effect for 1 MeV electrons was ~0.9 cm or 0.13 g cm^{-2}; in aluminum ~0.042 cm or 0.11 g cm^{-2}. In both materials the effect became negligible at depths of ~3 times the above values. The results agree fairly well with other experimental and theoretical results. Many factors have a significant influence on the accuracy of the results; several of them are controllable. In dry cellophane under ordinary room conditions, more than half the change in the dye is caused by the secondary action of active agents produced in the very small amount of water in the cellophane. (auth) (UK)

32475 RADIATIVE DISPERSAL AND DAMAGE TO SOME METALS IN RADIATION FIELD OF NUCLEAR REACTOR. PART II. DISPERSAL BY FISSION FRAGMENTS OF ^{235}U AND NEUTRONS FROM REACTOR. Garber, R. I.; Karasev, V. S.; Kolyada, V. M.; Fedorenko, A. I. At. Energ. (USSR); 28: 406-10(May 1970). (In Russian).

Results of a study are described of dispersal of atoms emitted from surfaces of single and polycrystal targets of 13 pure unfissionable metals under irradiation from the back side by fission fragments of ^{235}U in contact with targets and neutron flux in the nuclear reactor. The dispersal yield and angular distribution of dispersed particles have been investigated by use of active deposits of dispersed atoms on collectors, placed during irradiation near the target surface. A periodic dependence of the dispersal yield on the atomic number of targets has been observed. It has been shown that combined irradiation of polycrystal targets by fission fragments and neutrons from the reactor does not result in significant increase of the dispersal yield as compared with irradiation by neutrons only. In the case of single crystals, combined irradiation results in an increase of the dispersal yield. For various targets, the single crystal dispersal yield is higher than in the case of polycrystals. Autoradiographical registration of active deposits obtained as a result of dispersal of single crystals show discrete spots with symmetry corresponding to the orientation of the dispersion crystal side. As to polycrystals, the density distribution of particles along collectors follows the cosine law. Results of the investigation make it possible to accept the hypothesis of "mechanical," and not thermal, process of dispersal of atoms from the target surfaces under irradiation by fission fragments. (auth)

32476 RADIATIVE DISPERSAL AND DAMAGE TO SOME METALS IN RADIATION FIELD OF NUCLEAR REACTOR. PART I. DISPERSAL BY FAST NEUTRONS. Garber, R. I.; Karasev, V. S.; Kolyada, V. M.; Fedorenko, A. I. At. Energ. (USSR); 28: 400-6(May 1970). (In Russian).

Results of a study of dependence of a dispersal intensity for single and polycrystal targets on a reactor irradiation dose with neutron flux 2.10^{12} ncm^{-2} · sec^{-1}. It is found that the yield of dispersed particles from single crystals is higher than in the case of polycrystals. For single crystal as well as for polycrystal

targets a periodic dependence of dispersal yield on atomic number of the target element occurs. While the irradiation dose increases, the dispersal intensity in the case of single crystals decreases but remains higher than the dispersal intensity of polycrystals. It is shown that particles from single crystal surface are emitted mainly in the directions of densely packed rows of atoms, while from polycrystals emission is isotropic. Increase of the irradiation dose is accompanied by lessening anisotropy in the particle yield from single crystals, lowering their energies and broadening their energy spectrum. Energy spectra of particles from single and polycrystals are measured. Influence of electronic shells structure on the yield of dispersed particles from targets and their energy spectra, is observed and investigated. Atoms of elements belonging to the first subgroup of any period are emitted with higher velocities than atoms of elements of the second subgroup belonging to the same period. The maximum value of energy (up to 650 eV) is observed in the case of atoms of elements with very weak dispersion properties. Results of these investigations are interpreted by means of mechanisms of focusing collisions and canalizing displaced atoms in the crystal lattice of targets under neutron irradiation in the reactor. (auth)

32477 BIAXIAL STRESS RUPTURE TESTING OF IRRADIATED, CERAMIC-COATED INCOLOY 800. Moore, K. E.; Miller, J. R.; McCurnin, W. R. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 4-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32478 IRRADIATION-INDUCED CREEP IN AUSTENITIC STAINLESS STEELS. Gilbert, E. R.; Harding, N. E. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 143-4(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32479 DAMAGE FUNCTIONS FOR 304 STAINLESS STEEL. McElroy, W. N.; Simons, R. L.; Blackburn, L. D. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 144-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32480 EBR-II IN-PILE CREEP EXPERIMENTS ON STAINLESS-STEEL TUBING. Walters, L. C. (Argonne National Lab., Idaho Falls, Idaho); Walter, C. M.; Pugacz, M. A.; Tesk, J. A.; Carlander, R.; Li, Che-yu. Trans. Amer. Nucl. Soc.; 13: 145-6 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32481 MICROSTRUCTURAL ANALYSIS OF SWELLING IN EBR-II IRRADIATED STAINLESS STEELS. Brager, H. R.; Bates, J. F. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 146-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32482 HIGH-EXPOSURE, THERMAL REACTOR STAINLESS-STEEL IRRADIATION STUDIES. Kangilaski, M.; Bauer, A. A.; Wullaert, R. A. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc.; 13: 147-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32483 IRRADIATION-INDUCED VOIDS IN RHENIUM AND MOLYBDENUM. Kulcinski, G. L.; Mastel, B.; Brimhall, J. L. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 162-3(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Ceramics and Cermets

Refer also to abstracts 31673 and 32395.

Corrosion and Erosion

Refer also to abstract 32347.

Preparation and Fabrication

Refer also to abstracts 31222, 31446, 31459, 31541, 32361, and 32363.

32484 SELENOCOMPOUNDS OF MOLYBDENUM AND TRANSITION ELEMENTS. Bars, Odile; Sergent, Marcel; Grandjean, Daniel (Rennes Univ., France). Compt. Rend., Ser. C; 270: 1233-4(6 Apr 1970). (In French).
Selenocompounds of molybdenum and transition elements corresponding to the formula MMo_3Se_4(M = Fe, Co, Ni) were synthesized and characterized by their x-ray diffraction diagram. (auth) (France)

32485 BERYLLIUM-REINFORCED COMPOSITE MATERIALS. Taylor, William; Hawk, J. A. Jr. (Kawecki Berylco Industries, Inc., Reading, Pa.). J. Metals; 22: No. 6, 45-53(Jun 1970).
Several investigations are described aimed primarily at developing a material suitable for jet engine compressor stage turbine blading, with particular emphasis on the requirements of the rear, or hotter, compressor regions. In assessing a composite system, a number of qualifications are sought. The proposed system must be amenable to manufacture by some convenient process. It should have mechanical properties approaching those predicted from the properties and proportions of its constituents. In addition to the basic parameters of strength and elastic modulus, it must perform satisfactorily under complex service environments involving creep, fatigue and impact conditions for there is always the possibility that chemical reaction or mechanical incompatibility between the component materials will lead eventually to some unpredictable catastrophic failure mode. With regard to the latter requirement, it probably cannot be claimed that any composite system has been fully assessed in terms of the rear compressor stage environment. It appears that beryllium reinforced composite systems can be manufactured by convenient processes, and that they display properties which qualify them for service evaluation along with competitive fiber systems. In particular, the ductility of the beryllium systems is worthy of exploitation. (J.R.D.)

32486 VAPOR DEPOSITION OF RARE-EARTH OXIDES ON Zr-H FUEL. Young, W. A. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 4(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32487 SOLID SCRAP RECYCLE IN THE FABRICATION OF PLUTONIUM-URANIUM OXIDE. Strausberg, Sydney; Jones, L. J. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 33-4(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32488 CERAMIC NUCLEAR FUEL MICROSPHERES BY THE GEL-SUPPORTED PRECIPITATION PROCESS. Facchini, A. G. (AGIP Nuclear S.p.A., Milan). Trans. Amer. Nucl. Soc.; 13: 46-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32489 DEVELOPMENT OF BONDED BEDS OF COATED PARTICLES FOR HTGR FUEL ELEMENTS. Scott, J. L.; Conlin, J. A.; Coobs, J. H.; Hewette II, D. M.; Robbins, J. M.; Senn, R. L. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 134-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32490 PROCESS FOR MANUFACTURING AN ABRASIVE CONTAINING ZIRCONIUM AND ALUMINIUM OXIDE AND HAVING A HIGH GRAIN TENACITY. Mueller, Rodolf; Hack, Peter (to Dynamit Nobel Aktiengesellschaft). French Patent 1,546,934. 14 Oct 1968. Priority date 6 Dec 1966, Germany. (In French).
A procedure for increasing the strength of an abrasive grain with zirconium oxide and aluminum oxide base is described. The procedure consists essentially in exposing the grain to a thermal post-treatment at temperatures from 900 to 1300°C and preferably from 1100 to 1200°C. In such a procedure the best results are obtained in the thermal post-treatment of a grain in which the weight ratio of zirconium oxide to aluminum oxide is increased to about 4:6. (tr-auth)

32491 PROCESS FOR MANUFACTURING A ZIRCONIA-ALUMINA ABRASIVE WITH VERY HARD GRAINS. Bockstiegel, Gerd-Edzard; Hack, Peter (to Dynamit Nobel Aktiengesellschaft). French Patent 1,546,142. 7 Oct 1968. Priority date 2 Dec 1966, Germany. (In French).
A procedure is given for the fabrication of an abrasive grain of zirconia and alumina with great hardness. The procedure consists in the common fusion of zirconia and alumina and/or bauxite with subsequent cooling and crushing of the solidified fused mass. The procedure consists basically in avoiding as much as possible any

contact with nitrogen during the casting and solidification. Shortly before casting the fused mass, coke, anthracite, or analogous products are added in a granular form. The fused mass is covered with carbon dioxide and carbon dioxide blows out the mold in which the fused mass is cast. The weight ratio of zirconia to alumina is 4:6. (tr-auth)

Properties Evaluations

Refer also to abstracts 31534, 31592, 31624, 32373, 32380, 32415, 32426, 32702, 32922, and 33280.

32492 EVALUATION OF THE MICROHARDNESS OF TUNGSTEN CARBIDE USING THE SCANNING ELECTRON MICROSCOPE. Haglund, Bengt Olof (Sandvikens Jernverks AB, Stockholm). Prakt. Metallog.; 7: 173-82(Apr 1970). (In German and English).

The use of the transmission and scanning electron microscopes for the measurement of very small microhardness indentations is described. It is shown that the resolving power of the optical objective is inadequate in these cases and can in fact introduce a systematic error to the measurement. Indentations on the (0001) plane of a tungsten carbide single crystal produced with test loads of 5 to 100 gf were measured with the scanning electron microscope. The microhardness ranged from 3400 ± 500 to 2100 ± 90. It is also shown how the scanning electron microscope can be used to check the indenter. A method is described for calculating the microhardness directly from the indentation diagonals with a slide rule. (auth)

32493 DETERMINATION OF DIFFUSION PARAMETERS IN Mo–Ta AND W–Ta SYSTEMS. Ivanov, A. N.; Krasil'nikova, G. B.; Mitin, B. S. (Moscow Inst. of Steel and Alloys). Fiz. Metal. Metalloved.; 29: 204-6(Jan 1970). (In Russian).

Temperature dependence of the coefficient of interdiffusion of W–Ta was studied in the temperature range from 2100 to 2500°C and Mo–Ta from 1900 to 2300°C. (R.V.J.)

32494 ALUMINA CERAMICS AS A MATERIAL FOR THE VACUUM CHAMBERS OF PARTICLE ACCELERATORS. Droscha, H. Ber. Deut. Keram. Ges.; 47: 89-90(Feb 1970). (In German).

The use of sintered aluminum oxide for vacuum chambers of circular accelerators is outlined. Each segment of the ceramic material is joined to the next one by a ring consisting of a copper-nickel alloy. The joint is then welded. This arrangement not only prevents currents in the tube material but also increases solidity, freedom from oscillations, and resistance to high-energy radiation. After completion, the assembly can be heated and cleaned. Thus, working vacuums of 10^{-7} torr can be maintained. The superior efficiency of the arrangement was proven by the electron synchrotron DESY and by the electron accelerator built for the nuclear physics laboratory in Daresbury, Lancashire. (H.B.G.)

32495 NON-STOICHIOMETRIC PHASES $Nb_{1+x}Se_2$ AND $Ta_{1+x}Se_2$. Huisman, R.; Kadijk, F.; Jellinek, F. (Rijksuniversiteit, Groningen, Netherlands). J. Less-Common Metals; 21: 187-93(Jun 1970).

The non-stoichiometric phases $M_{1+x}Se_2$ (M = Nb, Ta; $0 < x < 0.3$) had structures built from MSe_2 slabs with M in trigonal-prismatic coordination; the x additional metal atoms lie in octahedral holes between the slabs. Depending on the composition and the temperature of preparation, various forms of $M_{1+x}Se_2$ were obtained which differed in the stacking of the MSe_2 slabs. Samples prepared at 800°C, for instance, were of the 3s- and 2s(b)-forms for $0.05 \leq x \leq 0.15$, while more metal-rich samples were of the 2s(a)-form. The metal-rich limit of the homogeneity range at 800°C lay at about $x = 0.29$ for $Nb_{1+x}Se_2$, and at about $x = 0.21$ for $Ta_{1+x}Se_2$. The phases $M_{1+x}Se_2$ were metallic with nearly temperature-independent paramagnetism. (auth)

32496 NEGATIVE THERMAL EXPANSION IN UZrH REACTOR FUEL. Meyer, R. D.; LeBlanc, J. G. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 2-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32497 CARBON COMPOSITES FOR REENTRY APPLICATIONS. Frye, E. R. (Sandia Labs., Albuquerque, N. Mex.). Trans. Amer. Nucl. Soc.; 13: 52(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32498 COMPATIBILITY OF $^{238}PuO_2$ WITH VARIOUS METALS. Selle, J. E.; English, J. J.; Schaeffer, D. R.; Teaney, P. E. (Monsanto Research Corp., Miamisburg, Ohio). Trans. Amer. Nucl. Soc.; 13: 82-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32499 IN-REACTOR MEASUREMENT OF THE INTEGRATED THERMAL CONDUCTIVITY OF UO_2 EFFECT OF POROSITY. Stora, J. P. (CEA, Grenoble). Trans. Amer. Nucl. Soc.; 13: 137-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32500 SPECIFIC HEAT OF UC AND UN. Affortit, Christian (CEN, Fontenay-aux-Roses, France). J. Nucl. Mater.; 34: 105-7(Jan 1970). (In French).

The specific heat of UC and UN was studied by a rapid heating method. The specific heat and enthalpy of UC was measured between 700 and 2800°K and 800 and 2300°K for UN. The results are tabulated, and the deviations from previous measurements are discussed. The equations best representing the experimental results are $C_p = 10.2 + 4.2 \times 10^{-3}T$ for UN ($1000°K < T < 2000°K$) and $C_p = 11.2 + 3.45 \times 10^{-3}T + (4.6 \times 10^{-10}/T^2)\exp(-60{,}000/RT)$ for UC ($800°K < T < 2800°K$). (J.S.R.)

32501 SPECIFIC HEAT STUDIES AT LOW TEMPERATURES (1.4 TO 20K). PART I. SINGLE CRYSTAL VANADIUM CARBIDES. PART II. ANTIFERROMAGNETIC LINEAR CHAINS: $Cu(NH_3)_4SeO_4.H_2O$ (COPPER TETRAMMINE SELENATE MONOHYDRATE), $Cu(NH_3)_4SeO_4$ (COPPER TETRAMMINE SELENATE), $Cu[(NH_2)_2C_3H_6]_2SO_4.H_2O$ (COPPER SULFATE DIAMMINE PROPANATE MONOHYDRATE). Lowndes, Douglas Henderson Jr. Boulder, Colo.; Univ. of Colorado (1969). 225p.

Thesis.

Construction and operating details are given for a cryostat and associated electronic and vacuum systems for precision specific heat measurements in the temperature range 1.5 to 20°K. The smoothness of the National Bureau of Standards (Washington) Provisional Acoustic Temperature Scale (1965) is checked, from measurements on copper of high electronic purity, obtained from the National Bureau of Standards (Boulder). Specific heat measurements on large, well-characterized single-crystal vanadium carbides, with varying carbon-to-metal ratio ($0.75 \leq C/Me \leq 0.87$) give good agreement with the position of a peak in the electronic density of states, predicted by the LCAO calculation of R. G. Lye. However, the magnitude of the experimentally observed density of states is less than that predicted by Lye. This would seem to be the first time that a detailed density-of-states calculation for a first row transition metal carbide has received substantial experimental support via direct (specific heat) measurements. The values obtained for the electronic specific heat coefficient, γ (mJ/mole-(K)^2), and the Debye temperature, θ_0(K), are: $\gamma = 3.05 \pm 0.04$, $\theta_0 = 690 \pm 14$ ($VC_{0.87}$), $\gamma = 3.40 \pm 0.03$, $\theta_0 = 721 \pm 8$ ($VC_{0.84}$), and $\gamma = 3.22 \pm 0.03$, $\theta_0 = 635 \pm 3$ ($VC_{0.75}$). These results do not agree with the few previous measurements on sintered samples. A method is described for preparing powdered samples, for specific heat measurements, so as to avoid the related problems of long thermal relaxation times and of the large background specific heat of most "binder" materials. The method allows one to conveniently make very precise measurements of the specific heat of powdered samples. Specific heat measurements have been made from 1.4 to 20°K for three copper tetrammine compounds: $Cu(NH_3)SeO_4 \cdot H_2O$, $Cu(NH_3)_4SeO_4$, and $Cu[(NH_2)_2C_3H_6]_2SO_4 \cdot H_2O$. The broad maximum in the specific heat of $Cu(NH_3)_4SeO_4 \cdot H_2O$, and the $1/T^2$ low temperature behavior for the other two samples, are interpreted as arising from infinite antiferromagnetically-coupled one-dimensional chains of ($S = \frac{1}{2}$) spins, with a nearly pure Heisenberg exchange interaction. Using the theory of Bonner and Fisher, the superexchange constants, $|J|$, are determined by the three samples. Finally, using our values of $|J|$ for $Cu(NH_3)_4SeO_4 \cdot H_2O$ and $Cu[(NH_2)_2C_3H_6]_2SO_4 \cdot H_2O$, and that determined by Griffiths for $Cu(NH_3)SO_4 \cdot H_2O$, together with crystal structure data for these isomorphous compounds, the dependence of the intrachain superexchange interaction on the separation, d, of Cu^{++} ions within the linear chains, is determined to be $|J| \propto d^{-(10\pm1)}$. (Diss. Abstr. Int., B)

Structure and Phase Studies

Refer also to abstract 32439.

32502 (MIT-3773-84) BASIC RESEARCH IN CRYSTALLINE AND NONCRYSTALLINE CERAMIC SYSTEMS. Annual Report. Kingery, W. D.; Coble, R. L. (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science). Apr 1970. Contract AT(30-1)-3773. 21p. Dep. CFSTI.

Research on fluorite structure materials, on nonstoichiometric compounds, and on solid solution oxides are reported. Results are

included from investigations of phase changes, diffusion, and ceramic microstructure. Other investigations were concerned with relations of properties with composition, crystal structure, and microstructure. Research is also reported on structure and properties of thin films and noncrystalline solids. (J.R.D.)

32503 TENSIMETRIC REFLECTION OF ATOMIC ORDER. Eyring, Leroy (Arizona State Univ., Tempe). J. Solid State Chem.; 1: 376-85(Apr 1970).

Phase reactions between the iota phase (M_7O_{12}) and those contiguous to it in the pure praseodymium and terbium oxide systems and in the ternary praseodymium–terbium–oxygen and terbium–cerium–oxygen systems are discussed in detail. Tensimetric studies revealed reproducible nonclassical behavior described as pseudophase formation in the hysteresis loops of the two-phase regions. Examination of these phase reactions by high-temperature x-ray analysis as they occurred gave additional information. The behavior of these systems is described in terms of microdomain formation derived from iota and the contiguous phases coherently intergrown. A parallel is suggested between these observations and the intergrowth and block structures in oxides which were among the last objects of study of David Wadsley. (auth)

32504 CRYSTAL STRUCTURE OF M-Nb_2O_5. Mertin, Wilhelm; Andersson, Sten; Gruehn, Reginald (Univ. of Kansas, Lawrence. Research Inst. of National Defence, Stockholm. Univ., Muenster, Ger.). J. Solid State Chem.; 1: 419-24(Apr 1970). (In German).

M–Nb_2O_5 was tetragonal and had the lattice constants a = 20.44 Å and b = 3.832 Å. The space group was 14/mmm. The presumable metastable niobium pentoxide modification could be obtained in various ways in the temperature region of about 900°C. Single crystals were obtained by chemical transport. In the M–Nb_2O_5 structure the Nb–O octahedra were arranged in blocks. They could be regarded as sections of a ReO_3 lattice. Formally, the structure of M–Nb_2O_5 was derived from the structure of N–Nb_2O_5. Perpendicular to the c axis the dimension of the blocks amounted to 4 × 4 octahedra diagonals. In this plane adjacent blocks were joined by edges. In the c direction the octahedra were linked by corners. (auth)

32505 NEW OBSERVATIONS IN THE SYSTEM TiO_2–Ta_2O_5. Mertin, Wilhelm; Gruehn, Reginald; Schaefer, Harald (Univ., Muenster, Ger.). J. Solid State Chem.; 1: 425-44(Apr 1970). (In German).

In the TiO_2–Ta_2O_5 system at high temperatures and with increasing ratio O/ΣMe (ΣMe = Ti + Ta) a solid solution of the rutile type, a compound $TiTa_2O_7$ and phases H2 and H1 related to H–Ta_2O_5 were observed. After heating in air at 1500°C, the rutile phase could accommodate up to 16 to 17 at.% Ta (Ti + Ta = 100%) at which composition the O/ΣMe ratio reached 2.05. The next higher phase which was probably isotypic to $TiNb_2O_7$ had the lattice constants, a = 11.847, b = 3.806, c = 20.39 Å, and β = 120.26°. In both compounds $Ti_2Nb_{10}O_{29}$ and $TiNb_{24}O_{62}$ partial substitution of Nb with Ta was realized. The H2 phase occurred in the region $2.467 \leq O/\Sigma Me \leq 2.484$ and had the lattice constants, a = 5.38, b = 5.35, c = 35.71 Å, and β = 91.66°(2.467 = O/ΣMe). The H1 phase (2.489–2.492 = O/ΣMe) had the lattice constants, a = 3.79, b = 3.81, c = 35.73 Å, and β = 90.79°. The lattice constants of H–Ta_2O_5 were determined to be, a = 3.78, b = 3.80, c = 35.74 Å, α = 90.20°, β = 90.96°, and γ = 89.97°. TiO_2 could dissolve in H–Ta_2O_5 down to an oxygen/metal ratio of 2.494. (auth)

32506 CRYSTAL STRUCTURE OF $MgNb_{14}O_{35}F_2$. Lundberg, Monica (Univ. of Stockholm). J. Solid State Chem.; 1: 463-8 (Apr 1970).

A phase analysis of the system MgF_2–Nb_2O_5 revealed the existence of the compound $MgNb_{14}O_{35}F_2$. The crystal structure was solved from three-dimensional Weissenberg data and refined by least-squares technique. The symmetry was monoclinic, space group C2/m and the unit cell dimensions: a = 20.628 Å, b = 3.825 Å, c = 19.098 Å, and β = 107.75°. The structure contained metal–oxygen (fluorine) octahedra which were linked by corners to form blocks measuring 5 × 3 × ∞ octahedra. The blocks were mutually connected along planes of crystallographic shear by octahedra sharing edges. The structure represented the previously missing member n = 5 of a series of monoclinic block structures $Me_{2n}X_{5n-1}$ found in the TiO_2–Nb_2O_5 system by Wadsley. (auth)

32507 CRYSTAL STRUCTURE OF MONOCLINIC WOLFRAM VANADIUM OXIDE, $W_3V_3O_{19}$, AN OD STRUCTURE RELATED TO R-Nb_2O_5. Israelsson, Mats; Kihlborg, Lars (Univ. of Stockholm). J. Solid State Chem.; 1: 469-77(Apr 1970).

The monoclinic ternary phase in the W–V–O system reported by Freundlich was studied by x-ray diffraction methods. A careful phase analysis indicated a composition close to $W_3V_3O_{19}$ and this was confirmed by the results of the crystal structure determination. The least-squares refinement of the structure resulted in a conventional R = 0.073. The unit cell dimensions were a = 24.41 Å, b = 7.446 Å, c = 3.950 Å, and β = 91.03° and the space group was C2/m. The structure was basically the same as that of R–Nb_2O_5 and $(Mo_{0.3}V_{0.7})_2O_5$ which were built up of MO_6 octahedra sharing edges and corners as in V_2O_5 although with a different pattern for the off-center displacements of the metal atoms inside the octahedra. Tungsten and vanadium were partly orderly distributed which gave rise to a superstructure. Two positions were occupied by W and V, respectively, and the third statistically by ($\frac{1}{4}$ W + $\frac{3}{4}$V) with no indications of order. ESCA measurements and considerations of the M–O bond lengths suggest that tungsten was hexavalent while vanadium was pentavalent in the singly occupied position and tetravalent in the site shared with tungsten. The structure was an OD structure, since a part of the diffraction spots was diffuse. A model is proposed which explains the partial disorder as due to mistakes analogous to stacking faults. (auth)

32508 CRYSTAL STRUCTURE OF BETA-POTASSIUM DIZIRCONATE: β-$K_2Zr_2O_5$. Gatehouse, B. M.; Lloyd, D. J. (Monash Univ., Clayton, Australia). J. Solid State Chem.; 1: 478-83 (Apr 1970).

A structural investigation of compounds existing in the K_2O–ZrO_2 phase system started with the high temperature preparation of single crystals of the orthorhombic 1:2 compound, beta-potassium dizirconate which had unit cell dimensions of a = 5.85, b = 10.79, and c = 8.76 Å. The structure was of a new type containing a complicated three-dimensional network of distorted ZrO_6 octahedra which was best described as comprising very condensed chains of alternating face- and edge-sharing ZrO_6 octahedra which doubled up to allow corner sharing of octahedra removed in the chain by two units. This latter phenomena occurred in such a manner that, within the chains and running in the same direction, there existed a string of trigonal bipyramidal holes linked by a common pair of oxygen atoms. Each octahedral chain, encased in a pseudohexagonal tunnel of potassium ions, was surrounded by and joined laterally to four mirror images by corner-sharing of octahedra. Overall, an unusually wide variety of structural features existed in this compound. Structural trends seen developing in the K_2O–ZrO_2 system from a consideration of the structure of the 1:1 and 1:2 compounds, are discussed and likely structures for the 2:1 and 1:3 compounds are presented. (auth)

32509 MIXED OXIDES OF THE TYPE MO_2(FLUORITE)-M_2O_3. V. PHASE STUDIES IN THE SYSTEMS ZrO_2–M_2O_3 (M = Sc, Yb, Er, Dy). Thornber, M. R. (CSIRO, Wembley, Australia); Bevan, D. J. M.; Summerville, E. J. Solid State Chem.; 1: 545-53(Apr 1970).

Results of phase studies on the systems ZrO_2–M_2O_3 (M = Sc, Yb, Er, Dy) are reported. Room-temperature x-ray diffraction of quenched and annealed samples was the main technique used, and the difficulties inherent in this approach to the determination of phase equilibria are discussed. Many of the data so obtained probably related to metastable states, the nature of which is discussed in the light of structural information on ordered intermediate phases in the ZrO_2–Sc_2O_3 and ZrO_2–Yb_2O_3 systems. Some speculations on the question of the stability and structure of grossly nonstoichiometric phases observed in various composition regions of these systems are made. (auth)

32510 STUDY OF THE EQUILIBRIUM DIAGRAM UC–UC_2 BY X-RAY DIFFRACTION AT HIGH TEMPERATURE. Laugier, Jean; Blum, Pierre L. (CEA, Grenoble, France). Compt. Rend., Ser. C; 270: 1358-61(20 Apr 1970). (In French).

X-ray diffraction studies made at high temperature show that the equilibrium diagram UC-UC_2 should be modified. U_2C_3 decomposition is effected by the following reaction: $U_2C_3 \rightleftharpoons UC_{1+x} + UC_{1+x'}$ at 1790 ± 30°C (x = 0.10; x' = 0.69). One of those cubic solid solutions, $UC_{1+x'}$, is obtained by an eutectoid reaction at 1700°C: $U_2C_3 + UC_2 \rightleftharpoons UC_{1+x'}$. (auth) (France)

32511 CRYSTAL STRUCTURE OF THORIUM CARBOHYDRIDES. PART I. CUBIC THORIUM CARBOHYDRIDE. Makovec, M.; Ban, Z. (Ruder Boskovic Inst., Zagreb. Univ., Zagreb). J. Less-Common Metals; 21: 169-80(Jun 1970).

The crystal structure of the low-temperature thorium carbohydride(carbodeuteride) phase of general composition $Th_2CH(D)$ was determined by combining x-ray and neutron diffraction methods, NMR, automatic tensimetry, differential thermal analysis, and magnetic susceptibility measurements. In the fcc arrangement of thorium atoms, carbon was distributed statistically in octahedral holes. Only 60% the hydrogen(deuterium) was present in the crystal structure, occupying 52% of the tetrahedral and 8% of the octahedral interstices, the remainder was chemisorbed at the surface of the very fine, crystalline powder. At approxi-

mately 380°C, the cubic carbohydride(carbodeuteride) irreversibly transformed into hexagonal thorium carbohydride, Th_2CH_2. (auth)

32512 VANADIUM–OXYGEN SYSTEM: PHASE RELATIONS IN THE VANADIUM-RICH REGION BELOW 1200°C. Henry, J. L.; O'Hare, S. A.; McCune, R. A.; Krug, Marion P. (Bureau of Mines, Albany, Oreg.). J. Less-Common Metals; 21: 115-35(Jun 1970).

Alloy specimens in the high-vanadium region of the vanadium–oxygen system were prepared by the reaction of high-purity vanadium foil and oxygen. The system was studied by x-ray and metallographic examination of quenched specimens, by differential thermal analysis (D.T.A.), and by high-temperature x-ray. Solubility was determined as a function of temperature at equilibrium pressure. Equilibrium pressures were not measured. The solubility of oxygen in α-vanadium—1.1 wt % at 250°C, 1.3 wt % at 400°C, 2.8 wt % at 1000°C, and 3.5 wt % at 1200°C—was found to be higher than previously reported. Retention of the high-temperature structure of α-vanadium by quenching was dependent upon the oxygen content and the quench rate. The α-phase could not be retained above 2.1 wt % oxygen even when water quenched from 1000°C. A peritectoid transformation was found at about 510°C between 2.2 and 4.2 wt % oxygen. The peritectoid phase, V_3O (s.s.), had a composition range at 400°C of 2.9 to 3.9 wt % oxygen. A martensite structure resulted from water quenching α-vanadium alloys having oxygen contents from about 2.2 to 3 wt %. The martensite transformed to the stable V_3O upon reheating to temperatures in the range 200 to 250 °C. Beta-vanadium had a composition range at 1000°C from 4.3 to slightly over 10 wt % oxygen. (auth)

32513 ROENTGENOGRAPHIC INVESTIGATIONS ON SPLIT STRUCTURES OF THE Cr_3Si TYPE. von Philipsborn, H. (Eidgenoessische Technische Hochschule, Zurich). Z. Kristallogr.; 131: 73-87(Mar 1970). (In German).

In general, Cr_3Si-type compounds form solid solutions. In solid solutions $A_3B: A_3'B' = 1:1$ (A = or ≠ A', B ≠ B') a split structure of the CsCl type for the B,B' atoms was not observed in the 34 systems investigated and under the conditions of preparation used. (auth)

32514 TERNARY SYSTEMS Me–C–H AND Me–N–H. Samsonov, G. V.; Antonova, M. M.; Morozov, V. V. (Inst. of Problems in Studies Materials, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 4, 66-79(Apr 1970). (In Russian).

Results of roentgeno- and neutronographic investigation of ternary hydride phases in the systems Me–C–H and Me–N–H (where Me = Ti, Zr, Hf, V, Nb, La, Y) are presented. Investigation of the hydrogen position in the above-mentioned phases shows the tendency of the initial hexagonal and cubic lattices of carbides to ordering as a result of hydrogen introduction. On the basis of the electronic structure of carbides and nitrides some assumptions are advanced on the type of chemical bond in carbohydrides and nitridohydrides of transient metals. (auth)

32515 COMMENTS ON "STABILITY OF THE GAS BUBBLES IN SOLIDS, BY G. P. TIWARI". Loh, B. T. M.; Farrell, K. (Oak Ridge National Lab., Tenn.). J. Nucl. Sci. Technol. (Tokyo); 7: 274-5(May 1970).

Arguments are offered in refutation of conclusions drawn by G. P. Tiwari that gas bubbles should grow spontaneously in solids. It is shown that the chemical potential of atoms lying on holes in solids is lower than that for atoms lying on a plane surface. This provides the driving force to sinter powder metallurgy billets or erase surface scratches. In cases of bubbles having a positive radius, equilibrium can be reached by vacancy diffusion. Bubbles conform to a critical size defined by a particular set of circumstances. (J.R.D.)

32516 CRYSTAL STRUCTURES OF Hf_3N_2 AND Hf_4N_3. Rudy, Erwin (Aerojet-General Corp., Sacramento, Calif.). Met. Trans.; 1: 1249-52(May 1970).

The crystal structures of ϵ-Hf_3N_2 and ζ-Hf_4N_3 were determined from x-ray powder photographs. The structure of both phases was trigonal, space group D_{3d}^5-$R\bar{3}m$, with unit cells of $a_R = 7.972$Å, $\alpha = 23°12'$ (hexagonal axes: a = 3.206Å, c = 23.26Å) for ϵ-H_3H_2, and $a_R = 10.54$Å, $\alpha = 17°32'$ (hexagonal axes: a = 3.214Å, c = 31.12Å) for ζ-Hf_4N_3. The nine close packed metal layers in ϵ-Hf_3N_2 were stacked according to $(hhc)_3$, or ABABCBCAC. The structure of ζ-Hf_4N_3, isomorphous with ζ-V_4C_3, consisted of twelve close-packed metal layers in a stacking sequence $(hhcc)_3$. The nitrogen atoms occupied octahedral interstices in the metal lattice. The experimentally observed compositions, $Hf_3N_{1.69}$ and $Hf_4N_{2.56}$, showed both phases to be substantially deficient in nitrogen. ϵ-Hf_3N_2 was unstable above ~2000°C and ζ-Hf_4N_3 above ~2300°C. (auth)

32517 SYSTEMS EuO–EuX_2 (X equals F, Cl, Br). Tanguy, Bernard; Frit, Bernard; Levasseur, Alain; Olazcuaga, Roger; Fouassier, Claude (Bordeaux Univ., Talence, France). Compt. Rend.; Ser. C; 270: 1239-42(6 Apr 1970). (In French).

The study of the systems EuO–$EuCl_2$ and EuO–$EuBr_2$ revealed the two unknown oxyhalides Eu_4OCl_6 and Eu_4OBr_6 isotopic with the corresponding alkaline-earth compounds. Their magnetic properties were determined between 20 and 250°K. No fluorinated compound could be observed. (auth) (France)

Radiation Effects

Refer also to abstracts 33229, 33230, 33233, and 33457.

32518 (GA-10001) EFFECT OF TEMPERATURE HISTORY ON THE DIMENSIONAL CHANGES OF NUCLEAR GRAPHITES. Engle, G. B. (Gulf General Atomic, Inc., San Diego, Calif.). 23 Mar 1970. Contract AT(04-3)-167. 14p. Dep. CFSTI.

When anisotropic needle-coke graphites and near-isotropic graphites were irradiated initially to ~3×10^{21} n/cm² at ~1000°C and then to higher fluences at 760 to 800°C, the rate of dimensional change did not adjust to the slower rate expected for the lower temperature. When the initial irradiation was done at 1450°C to ~3×10^{21} n/cm² and was followed by irradiation at 1225 to 1250°C to 9×10^{21} n/cm², the dimensional change rate was higher than that for specimens irradiated to 9×10^{21} n/cm² entirely at 1225 to 1250°C. (auth)

32519 POSTIRRADIATION EXAMINATION AND EVALUATION OF TUNGSTEN–URANIA CERMETS. Martin, W. R.; Richt, A. E.; Martin, M. M. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32520 HIGH-TEMPERATURE IRRADIATION BEHAVIOR OF UN, UC, AND UO_2 COMPARED. Hilbert, R. F.; Storhok, V. W.; Chubb, W. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc.; 13: 102-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32521 IRRADIATION BEHAVIOR OF UO_2 AT SURFACE TEMPERATURES FROM 1300 TO 1900°C. Hilbert, R. F.; Storhok, V. W.; Chubb, W. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc.; 13: 132(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32522 RELEASE OF ^{85}Kr FROM gamma' MANGANESE DIOXIDE SUBJECTED TO HEAT TREATMENTS AND ION BOMBARDMENT. Bussiere, Paul (Centre National de la Recherche Scientifique, Villeurbanne, France); Jech, Cestmir. Compt. Rend., Ser C.; 270: 1215-18(6 Apr 1970). (In French).

The study of the release from $MnO_2\gamma$, of a radioactive rare gas incorporated by ion bombardment revealed a different behavior of the superficial layers of the samples subjected to heat treatments and presenting different textures through phase transformations between 200 and 400°C. (auth) (France)

Plastics and Other Materials

Refer also to abstracts 31322, 31424, 31425, 31539, 31546, and 32474.

32523 (NVO-38-24) DEVELOPMENT AND TESTING OF HIGH STRENGTH MATERIALS FOR LINING UNDERGROUND CHAMBERS. Final Report. Petry, W. L.; Rowland, R. E.; Finlayson, L. A. (Fenix and Scisson, Inc., Las Vegas, Nev.). Dec 1969. Subcontract FSLV-69S-1. 106p. Dep. CFSTI.

For IIT Research Inst., Chicago, Ill.

Candidate materials for lining underground chambers were tested for tensile strength, flexural strength, fluxural modulus, compressive modulus, compressive strength, linear shrinkage, thermal expansion, specific gravity, water absorption, and metal bonding. Results of these and other tests are summarized. (W.H.K.)

32524 (ORNL-4526, pp 83-96) RESEARCH MATERIALS. (Oak Ridge National Lab., Tenn.).

FERRATES—growth of monocrystals for neutron beam polarization

GALLIUM TUNGSTATES—growth of $GaWO_4$ monocrystals

GERMANIUM — growth and evaluation of monocrystals of
INFORMATION CENTERS — activities at Research Materials
MAGNESIUM NITRATES — preparation and properties of basic
MAGNESIUM OXIDES — growth of clear monocrystals of
MAGNESIUM SILICATES — growth of $MgSiO_3$ and Mg_2SiO_4 monocrystals
METALS — growth of pure monocrystals of
POTASSIUM MAGNESIUM FLUORIDES — growth of doped monocrystals of
SINGLE CRYSTALS — growth of high-purity, research on
— list of ORNL-loaned ultrapure and controlled-impurity
STRONTIUM CHLORIDES — growth of doped monocrystals of
(D.L.C.)

32525 QUALITY CONTROL OF CONCRETE USING NEUTRON MOISTURE GAUGE. Yamamoto, Moriyuki; Mizushina, Tomoyuki (Taisei Construction Co., Ltd., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 178-82(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

In continuous mixing of standardized mixture, the fluctuations in moisture content of fine aggregate (river sand) cause fluctuations of the cement-water ratio, concrete slump, and concrete strength. It has become increasingly important that a quick, simple, and accurate method of automatic control in the weighing beam system of the batching plant be developed. A trial method was developed to keep the mixture standard. A neutron moisture gage was set in a bin of fine aggregate because the fluctuations in moisture content of fine aggregate cause the most serious effect on the poor uniformity mixing. Rapid, accurate and continuous measurement of the moisture content of fine aggregate was indicated as a voltage signal by the neutron moisture gage. The signals were fed back to the automatic control system, and the weighing of water and fine aggregate controlled. The results were as follows: standard deviation of concrete slump; 18 ± 0.6 cm; and standard deviation of concrete strength; 292 ± 20 kg/cm^2. (auth)

32526 LONG-TERM RADIATION-INDUCED CONDUCTIVITY IN POLYETHYLENE TEREPHTHALATE. Ballard, Lewis Franklin. Durham, N. C.; Duke Univ. (1969). 92p.

Thesis.

Radiation induced conductivity (RIC) in polyethylene terephthalate (PET) is studied in amorphous and partially crystalline samples exposed to ^{60}Co gamma rays. Emphasis is placed on persistent RIC which exists for a long period of time after exposure. The drift mobility of holes in PET is observed by a pulsed photoconductivity technique to be near 2×10^{-3} cm^2 v^{-1} sec^{-1}. By the same method, the carrier mobility in dimethylterephthalate (DMT), a model compound for the PET polymer, is found to be near 0.8 cm^2 v^{-1} sec^{-1} for holes and 0.05 cm^2 v^{-1} sec^{-1} for electrons. Significant reduction in the mobility after irradiation is observed. The primary source of the long term RIC which becomes significant at radiation doses above 10^6 rads is concluded to be an increase in the carrier concentration. A model and experimental evidence are presented which relate this increased carrier concentration to free radical accumulation in doping levels lying within a few kT of the valence level. These carriers move through PET by a hopping process which is limited in the steady state by traps located near 1.0 eV having a density of about 10^{15} cm^{-3}. (Diss. Abstr. Int., B)

PHYSICS (GENERAL)

Astrophysics and Cosmology

Cosmic Ray Exposure Ages

32527 ABUNDANCE OF ^{244}Pu IN THE EARLY SOLAR SYSTEM. Podosek, F. A. (Univ. of California, Berkeley). Earth Planet. Sci. Lett.; 8: 183-7(Apr 1970).

The abundance ratio $^{244}Pu/^{238}U$ at the time the St. Severin meteorite began to retain xenon was determined to be 0.0127 ± 0.0026 by a method involving only xenon isotope ratio measurements. (auth)

32528 SIMULATING NUCLEAR REACTIONS OF COSMIC-RAY INTERACTIONS WITH THE MATERIAL OF STONY METEORITES. Lavrukhina, A. K.; Revina, L. D.; Malyshev, V. V.; Yukina, L. V.; Satarova, L. M.; Akolzina, L. D.; Kalicheva, I. S. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 5, 531-9(May 1970). (In Russian).

The possibility of using semiempirical equations of Rudstam and Oeschger–Schwarz for the calculation of cross sections of spallation product formation from a target of complicated chemical composition was studied. For this purpose the material of the stony meteorites Zaisan lake and Kunashak was irradiated by protons with a 660 MeV and 19.2 GeV energy respectively. The isolation of different fractions of elements was carried out radiochemically. The measured radioactivity values were compared with calculated values. For most of the studied isotopes an agreement in the ranges of the ≤2 coefficient was observed. On the whole the agreement is better for 660 MeV than for 19.2 GeV. This is possibly connected with the appearance of the mechanism of nuclei spallation in the region of E ≃ 10 GeV being qualitatively new in comparison with the cascade mechanism. (auth)

32529 RADIOCHEMICAL NEUTRON ACTIVATION ANALYSIS OF EXTRATERRESTRIAL MATERIALS. Wasson, John T. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 13: 54(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32530 ADVANCES IN SOLID SOURCE MASS SPECTROMETRY AND REFINED TIME RESOLUTION IN THE EARLY SOLAR SYSTEMS. Papanastassiou, D. A. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc.; 13: 56(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32531 ^{37}Ar AND ^{39}Ar IN RECENTLY FALLEN METEORITES AND COSMIC-RAY VARIATIONS. Fireman, E. L.; Goebel, R. (Smithsonian Institution Astrophysical Observatory, Cambridge, Mass.). J. Geophys. Res.; 75: 2115-24(10 Apr 1970).

The 35-day ^{37}Ar and the 270-year ^{39}Ar isotopes were measured in the iron–ataxite meteorite, Alandroal, that fell on November 14, 1968, and in two recently fallen stony meteorites, Allende, that fell on February 14, 1969, and Sprucefield, that fell on April 25, 1969. The $^{37}Ar/^{39}Ar$ ratio in Alandroal is 0.50 ± 0.03, which is considerably lower than that measured in previous iron meteorites and a factor of 2 lower than the ratio of 1.09 ± 0.05 expected if the high-energy (>300 MeV) cosmic rays were constant. In the autumn of 1968, the high-energy cosmic-ray flux near 1 AU was 0.46 ± 0.07 of the flux during the previous several hundred years near the apogee of the orbit of Alandroal (probably near 4 AU). The $^{37}Ar/^{39}Ar$ ratio in the iron phase of Sprucefield is 0.90 ± 0.09, which requires that the high-energy cosmic-ray flux in the spring of 1969 near 1 AU be approximately the same as the flux near the apogee of the orbit of Sprucefield (probably near 1 AU) during the previous several hundred years. A small orbit for Sprucefield is also indicated by the loss of spallation ^{3}He and ^{21}Ne and of radiogenic ^{4}He and ^{40}Ar, which indicate solar heating. From the $^{37}Ar/^{39}Ar$ ratio in Alandroal, a lower limit of +15% per AU is obtained for the average gradient of the cosmic-ray flux with distance from the sun. In the Allende whole rock and in the stone phase of Sprucefield, the ^{37}Ar is produced almost entirely by secondary neutrons. The radioactivities, ^{3}H, ^{22}Na + ^{36}Al, ^{60}Co, and the stable rare-gas isotopes were also measured, and exposure ages were determined. The radioactivities and stable rare gases were also measured in the stony meteorite Ankobar, which fell on July 7, 1949. No argon radioactivities were detected in the iron ataxite Deep Springs, which indicates that it landed more than 2000 years ago. (auth)

Stars

32532 PLANETARY NEBULAE. Gurzadyan, G. A. New York; Gordon and Breach, Science Publishers, Inc (1969). 329p. $27.50.

Translated and Edited by D. G. Hummer.

A comprehensive survey of the observational material and of theoretical work on planetary nebulae is given. A substantial portion of the book is devoted to the author's own research, especially on the origin, evolution, and morphology of these objects. The present translation incorporates nearly eighty pages of new material prepared since the original edition. (W.D.M.)

32533 SPECTROSCOPIC OBSERVATION OF THE η ARIETIS STAR. Baranne, Andre; Spite, Francois; Spite, Monique (CNRS, Marseille. Observatoire de Haute, Provence, France. Observatoire de Paris, Meudon, France). Compt. Rend., Ser. B; 270: 916-17(6 Apr 1970). (In French).

Two spectra of the η Arietis star were studied. This star does not seem to be deficient in iron, as had been thought, but might be deficient in vanadium. (France)

32534 HALOING EFFECT OF THE THIRD INTEGRAL. Deprit, Andre; Henrard, Jacques (Boeing Scientific Research Labs., Seattle). Astrophys. Space Sci.; 7: 54-70(Apr 1970).

Whether Contopoulos's galactic system is separable (unlikely) or not (likely), the fact is that there exists a vicinity of the equilibrium in which numerical integration of high accuracy cannot separate the system from its image through Birkhoff's normalization of high order. To all practical purposes, stellar dynamics is then justified in pretending that the model is, in that region, structured by a so-called third integral. (auth)

32535 CONVECTIVE ENERGY TRANSPORT IN STELLAR ATMOSPHERES. I. A CONVECTIVE THERMAL MODEL. Ulrich, Roger K. (Univ. of California, Berkeley. California Inst. of Tech., Pasadena). Astrophys. Space Sci.; 7: 71-86 (Apr 1970).

The treatment of convection in the presence of nonuniformities associated with the superadiabatic layer of model atmospheres requires more information than is available from the standard mixing length theory. The meteorological model known as the convective thermal is discussed for the purpose of obtaining the strength of coupling between adjacent layers with different properties. As in the standard mixing length theory the principal uncertainty remains the average initial radius of the cells. This initial radius is determined to be between 700 and 950 km by a comparison to solar granulation. (auth)

32536 A SPECTROGRAPHIC STUDY OF R CANIS MAJORIS. Galeotti, Piero (CNR, Merate, Italy). Astrophys. Space Sci.; 7: 87-92(Apr 1970).

New spectroscopic elements of R Canis Majoris are given, computed from 17 plates secured at the Astronomical Observatory of Merate. A new orbit was also computed with the program by Bertiau from 81 observations covering a period of about 40 years. Two models of this binary system are proposed, based on two different assumptions and on a newly determined mass function. It is confirmed that the main peculiarity of this binary with regard to the mass–luminosity relation is real; there is also an evidence of mass loss from the Lagrangian point L_2 as suggested by Kitamura. A suspected variation of the velocity V_0 of the center of mass seems to indicate the presence of a third body. The evidence is, however, not yet conclusive. (auth)

32537 AN INVARIANT-IMBEDDING APPROACH TO SPECTRAL-LINE FORMATION BY NONCOHERENT SCATTERING. Fuller, F. B.; Warming, R. F. (Ames Research Center, Moffet Field, Calif.). Astrophys. Space Sci.; 7: 93-118(Apr 1970).

Spectral-line formation under the assumption of complete frequency redistribution is studied for a plane-parallel atmosphere containing a nonuniform distribution of internal emission sources. Solutions for the emergent intensity profiles and surface values of the net flux and source function are all given in terms of functions defined as weighted moments of an auxiliary function. These functions include the generalized X and Y functions. The computational problem is then reduced to an initial-value problem consisting of a coupled system of first-order ordinary differential equations. A description of the numerical calculations is given, and several graphical solutions are included to illustrate emergent intensity profiles of Doppler-broadened lines. (auth)

32538 A STUDY OF THE STRUCTURE OF RAPIDLY ROTATING CLOSE BINARY SYSTEMS. Martin, Peter G. (Univ. of Toronto). Astrophys. Space Sci.; 7: 119-38(Apr 1970).

A polytropic theory for investigating the structure of rapidly rotating close binary systems is developed on the basis of the works of Chandrasekhar (1933) and Monaghan and Roxburgh (1965). In this method each component is divided into an inner and outer region; it is shown that the inner region is the interior of the Emden sphere. Solutions for the interior and exterior potentials and densities are found, consistent to the seventh power of the ratio of the undistorted radius (a) to the separation (R); i.e. $(a/R)^7$. The surface, surface gravity, and potential are found. These results are used to discuss the critical configurations and contact equipotentials, and the existence of semi-detached and contact binary systems. The theory is compared to previous work, in particular the case of rotation alone and the Roche model. (auth)

32539 THE EXISTENCE OF THE THIRD INTEGRAL FOR A FAMILY OF HIGH-VELOCITY STARS. Innanen, K. A.; House, F. C. (York Univ., Toronto). Astrophys. Space Sci.; 7: 139-50(Apr 1970).

A family of high-velocity stars (energy 19,000 km_2/sec^2, angular momentum 1150 kpc km/sec) were computed using Innanen's (1966) mass model of the Galaxy. The stars were set initially on the curve of zero velocity. The inclination diagram indicates a quasi-isolating third integral. (auth)

32540 A PERTURBED RED-GIANT MODEL. INFLUENCE OF RELATIVISTIC GAS CHARACTERISTICS. Edwards, Terry W. (Univ. of Missouri, Columbia). Astrophys. Space Sci.; 7: 151-9(Apr 1970).

A Population II, 1.3 $M_\odot$, pre-helium flash, red-giant model was investigated with respect to the influence of inclusion of relativistic gas characteristics, i.e., the equations of state, entropy, specific heats, and the adiabatic gradient. Little change was found in the observable properties of the model, but slightly larger changes were found in the interior properties, the most important of which was the narrowing of the already thin radiative zone between the hydrogen burning shell and the extensive outer convective envelope from 9.6 to 8.0 density scale heights. (auth)

32541 LOWER MASS LIMIT TO THE MAIN SEQUENCE. Straka, William Charles. Los Angeles; Univ. of California (1969). 200p.

Thesis.

The theoretical lower mass limit to the main sequence was determined, using three variations of physical parameters in the envelopes of the models. The limiting mass obtained is found to be less sensitive to a change in opacity than to a change in the ratio of mixing length to scale height. The position of the models in the H-R diagram is found also to be less sensitive to changes in opacity than to a change in the ratio of mixing length to scale height. (TSS) (Diss. Abstr. Int. B)

32542 RECENT PROGRESS IN CALCULATION OF STELLAR OPACITY. Cox, A. N. (Univ., Liege). Bull. Cl. Sci., Acad. Roy. Belg.; 55: 771-82(1969). (In French).

Some of the additions to the Los Alamos tables of stellar opacity and bound-bound absorption effects are tabulated. The present knowledge on the thermodynamic properties and the absorption of stellar matter as shown in the tables is summarized. The most important studies on stellar opacity published in the last three years are reviewed. These include the calculation of monochromatic absorption due to water vapor, a criticism of the approximation made in the calculation of the average charge in the process of free-free absorption, ratio of opacity with the Baerentzen/Cox rays, criticisms on the hydrogen approximation of the atom in combination with a new method for the calculation of the potential of electrons, the effect of autoionization rays on the opacity, and the effect of the collective effects in electron scattering. (J.S.R.)

32543 CATALOG OF INDIVIDUAL RADIAL VELOCITIES, 0^h TO 12^h, MEASURED BY ASTRONOMERS OF THE MOUNT WILSON OBSERVATORY. Abt, Helmut A. (Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., Suppl. Ser. 19: 179; 387-505(Jun 1970).

For those stars for which only undated mean velocities have been published by Mount Wilson astronomers, the individual velocities, times of observation, and other pertinent data are given. Included in this catalog are approximately 11,000 velocities of 3,500 stars, observed and measured between 1909 and 1951. (auth)

32544 SEMICONVECTION. Spiegel, E. A. (New York Univ., N. Y.). Comments Astrophys. Space Phys.; 1: 57-61(Mar-Apr 1969).

No serious objection has been raised to the general Schwarzschild-Harm (1958) prescription for semiconvection in the evolution of large-mass stars, but some question has arisen about their definition of convective neutrality. In view of recent indications that even stars of solar mass eventually go through a semiconvective phase, it was felt desirable to review this question of the convective neutrality condition. (W.D.M.)

32545 RED AND BLACK DEGENERATE STARS. Greenstein, Jesse L. (California Inst. of Tech., Pasadena). Comments Astrophys. Space Phys.; 1: 62-72(Mar-Apr 1969).

The nonobservability or rarity of late-type, cool degenerate stars requires analysis in terms of the current theory of the internal energy available for radiation from the surface. The fundamental hypotheses are given and the physics and models are discussed. Other topics considered include the rarity of red degenerate stars, speculations on space density, and results of simplified cooling theory. (W.D.M.)

32546 GRAVITATIONAL INSTABILITY AND COLLAPSE OF CHARGED FLUID SHELLS. Chase, J. E. (Univ. of Alberta, Edmonton). Nuovo Cim.; 67B: 136-52(11 Jun 1970).

A solution of Einstein's field equations is derived, representing a thin spherical shell of charged fluid, falling in a spherically symmetric field due to mass and charge at its center. No restrictions are placed on the equation of state. By integrating the equations of motion, the law of conservation of total energy is obtained and used to study the equilibrium states of the system, and their stability against collapse. It is found, under reasonable assumptions, that for a given equation of state and a given entropy, there is a maximum equilibrium mass, and that instability sets in at a critical radius which is always larger (very much larger, for a shell of highly relativistic fluid) than the upper Nordström gravitational radius. For uncharged bodies, these results completely parallel, and serve as a simple illustration of, the results of the much more complicated analyses needed for fluid balls. (auth)

32547 EVOLUTION OF CLOSE BINARY SYSTEMS WITH INITIAL COMPONENTS OF 2 AND 1.5 $M_\odot$. Giannone, P.; Giannuzzi, M. A. (Osservatorio Astronomico, Rome). Astron. Astrophys.; 6: 309-17(Jun 1970).

The evolution of the originally more massive stars of three close binary systems was computed through the phase of mass exchange between the components. The systems have $M_1 + M_2 = 3.5\ M_\odot$, initial mass ratio 0.75 and three different initial separations of 7 $R_\odot$, 10 $R_\odot$, and 15 $R_\odot$. Conservation of total mass and total orbital angular momentum is assumed. The beginning of mass transfer occurs after the exhaustion of central hydrogen in the primaries. At the end of mass loss, these stars result in white dwarfs of 0.280 $M_\odot$, 0.296 $M_\odot$, and 0.317 $M_\odot$. A comparison with observations is given. (auth)

32548 FINE ANALYSIS OF FIVE STARS OF THE γ LEONIS GROUP. Zielke, G. (Univ., Kiel). Astron. Astrophys.; 6: 206-18(Jun 1970). (In German).

Applying the method of fine analysis to five stars of the γ Leonis group, model parameters were determined from spectra and colors. HD 136202 was analyzed relative to the Sun, the other stars relative to HD 136202. Combining their effective temperatures and gravities with calculations of stellar evolution by Iben, "spectroscopic evolution parallaxes" π_{SE} were obtained. The π_{SE} were compared with the spectroscopic π_{Sp}, trigonometric π_{tr}, and group parallaxes π_{Gr}. The radial velocities were remeasured and the spatial motion is discussed. (W.D.M.)

32549 RADIAL VELOCITY OF EN (16) LACERTAE. Bloch, M.; Morguleff, N.; Terzan, A. (Observatorie de Haute Provence, Paris. Observatoire, Lyon). Astron. Astrophys.; 6: 322-4(Jun 1970). (In French).

The variations of radial velocity of EN (16) Lacertae were studied on spectrograms taken at Haute Provence Observatory on September 26, 1968. The results confirm the period of 0.169,166 day of the primary pulsation. (auth)

32550 EVOLUTION OF VERY MASSIVE STARS WITH PULSATIONAL MASS LOSS. Simon, N. R.; Stothers, R. (Goddard Inst. for Space Studies, New York). Astron. Astrophys.; 6: 183-92(Jun 1970).

Evolution with moderate mass loss was investigated for hydrogen-burning stars whose mass exceeds the critical mass for pulsational stability at the top of the main sequence. A prescription based on minimizing the degree of pulsational instability is used to specify the rate of mass loss. With a zero-age hydrogen abundance of X = 0.70 and electron-scattering opacity, stars of initially 60 to 115 $M_\odot$ become stable before the end of hydrogen burning; more massive stars evolve into unstable pure-helium stars of high mass. The smallest remnant left after hydrogen

burning is 12 $M_\odot$, for an initial mass of 115 $M_\odot$. The hydrogen-burning tracks stay close to the zero-age main sequence, and the mass-loss rate is remarkably uniform, 3×10^{-5} $M_\odot$ $year^{-1}$. The helium-burning phase is considered for the remnants of initially 100 and >115 $M_\odot$. In contrast with the possible cases of no significant mass loss or very rapid mass loss, the assumption of moderate mass loss seems to yield results consistent with the relevant observational data, particularly for the most luminous group of Wolf–Rayet stars. (auth)

32551 A SIMPLE MODEL FOR CEPHEID VARIABILITY. Rudd, T. J.; Rosenberg, R. M. (Univ. of California, Berkeley). Astron. Astrophys.; 6: 193-205(Jun 1970).

A simple, mathematically tractable one-zone model of Cepheid variability is constructed from the well-known nonadiabatic equations governing the process. The central feature of this model is that the equation of motion is discontinuous; e.g., the equation of the compression phase differs from that of the expansion phase. (The existence of this discontinuity was deduced from astronomical observations on δ-Cephei.) The difference between the compression and expansion phases is not qualitative but merely quantitative and, mathematically speaking, it may be arbitrarily small; nevertheless, it harbors the mathematical mechanism for the limit cycle. Necessary conditions for the existence of the limit cycle are derived, and the entire theory is applied to δ-Cephei. The predicted motion of the model preserves qualitatively and quantitatively that observed on δ-Cephei. (auth)

32552 THE GENERALIZED OHM'S LAW WITH RADIATION PRESSURE. Nakagawa, Y.; Kato, S. (High Altitude Observatory, Boulder, Colo. Tokyo Univ.). Astron. Astrophys.; 6: 254-60(Jun 1970).

A generalized Ohm's law was derived on the basis of the kinetic theory of an ionized gas mixture. The effect of radiation pressure is incorporated in the definition of the current density. It is shown that the effect of radiation pressure enters in the Ohm's law through the term proportional to the temperature gradient. The application of the results in relation to the thermal generation of magnetic fields by the "battery" mechanism proposed firstly by Biermann (1950) in rotating stars is briefly discussed. (auth)

32553 SPECTROPHOTOMETRIC STUDY OF 102 HERCULES. Kovachev, Kilment; Kovachev, Bogomil. Izv. Sekts. Astron., Bulg. Akad. Nauk.; 3: 63-76(1969). (In Russian).

On the basis of 18 spectrograms of the star 102 of the constellation Hercules, it is calculated that lg n_e = 13.50 (lg n_e = 14.58) and lg(N_H/N_{Ne}) = 0.51, the temperature of excitation T_e = 23000° and the temperature of ionization T_i = 22600°. It is concluded that this star, as far as its chemical composition is concerned, is close to the carbon stars of the late giants. (Abstr. Bulg. Sci. Lit.)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 32748 and 32783.

32554 (NP–18255) PLASMA MECHANISMS OF EMISSION IN PULSARS. Kaplan, S. A.; Tsytovich, V. N. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1970. 22p. Dep. CFSTI (U. S. Sales Only).

The authors have previously studied plasma radiation mechanisms in astrophysics (see NSA 23: Abstract Nos. 6988, 16622, and 39071). First pointing out that disparities exist in the models of the last two years that attempt to explain processes taking place in pulsars and supernova envelopes, they state that their aim in this paper is to derive, from the theory of plasma mechanisms of emission, the consequences that are more or less independent of the concrete models. In their development here, two possibilities are distinguished from the radiation mechanisms: (1) fast particles generate the hf radiation when scattered by turbulent plasma pulsations, and (2) particles accelerated by the turbulent pulsations give the usual synchrotron radiation. In both cases, stimulated emission is possible and gives a cosmic maser effect or "caser" effect (cosmic amplifier stimulated emission radiation) without which the very high effective brightness temperatures in pulsars can not be explained. It is concluded that: (1) the theory of plasma turbulence makes possible the estimation of parameters of the emitting region near pulsars and demonstrates the possibility of the "caser" effect transforming the major part of the turbulent energy into radiation energy; and (2) in a time less than the time of a subpulse, 10^{-3} sec, the plasma particles are able to accelerate up to very high energies, and can be one of the most important energy sources for the activity of supernova remnants. (L.M.T.)

32555 11 CM OBSERVATIONS OF SMALL NEBULAE ASSOCIATED WITH WOLF–RAYET STARS. Smith, Lindsey F. (Australian National Univ., Canberra); Batchelor, R. A. Aust. J. Phys.; 23: 203-16(Apr 1970).

Total masses of three small H II regions are derived from (1) total flux densities obtained from 11-cm observations with the 210-ft radio telescope of the Australian National Radio Astronomy Observatory, (2) electron densities derived from spectra of the λ3727 doublet of [O II], and (3) photometric distances for the stars associated with the nebulae. The nebulae are of particular interest because they are among seven now known that consist of an arc or arcs of nebulosity centered on a Wolf–Rayet star. Mass estimates made by Johnson and Hogg (1965) from radio observations at 21 cm (continuum) of two other of the seven nebulae are revised in accord with new photometric distances for the stars concerned. The derived masses range from 6 to 1000 $M_\odot$. (Australia)

32556 IDENTIFICATION OF SOUTHERN EXTRAGALACTIC RADIO SOURCES. Ekers, R. D. (Australian National Univ., Canberra). Aust. J. Phys.; 23: 217-21(Apr 1970).

Field classifications are given for 46 radio sources south of declination –44° for which suitable optical observations were available in September 1967. Identifications are suggested for 21 objects and finding charts are given for 7 objects not previously published. (Australia)

32557 LOW-LATITUDE GALACTIC SURVEY FROM l^{II} = 37 TO 47° AT 2.7 GHz. Day, G. A.; Warne, W. G.; Cooke, D. J. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 13, 11-16(Apr 1970).

Results of a survey of the galactic plane at 2.7 GHz from longitudes 37° to 47°, latitudes ±2°, are presented as a contour map and a source list giving the positions for 53 radio sources. The angular resolution is 8.2′ arc. A computer-drawn ruled-surface picture of the area is shown. A comparison is made between this survey and the survey carried out by Hughes and Routledge (1969) in the area common to both. The well-known radio sources associated with W47, W49, and W50 are contained in this section. (Australia)

32558 LOW-LATITUDE GALACTIC SURVEY FROM l^{II} = 6 TO 26° AT 2.7 GHz. Goss, W. M.; Day, G. A. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 13, 3-9(Apr 1970).

The galactic plane has been observed from l^{II} = 6° to 26° with an 8′ arc beam-width at 2.7 GHz. The latitude range covered was ±2°. Positions were determined for 103 sources and flux densities for 95 of these. A contour map for the region is presented. The well-known radio sources associated with M8, W28, M17, and M16 are contained in this survey. (Australia)

32559 PULSARS. Friedman, Herbert. Astronaut. Aeronaut.; 8: No. 4, 22-25; 61; 95(Apr 1970).

Topics discussed in this brief review include the discovery of pulsars, white dwarfs, neutron stars, the Crab Nebula, theories of pulsar radiation, physics of neutron stars, and gravitational collapse. (W.D.M.)

32560 THE VARIABLE X-RAY SPECTRUM OF CYG XR-1. Dolan, Joseph F. (Case Western Reserve Univ., Cleveland). Space Sci. Rev.; 10: 830-68(Jun 1970).

The variability of the x-ray spectrum of the discrete source Cyg XR-1 is reviewed. The variations observed in the energy region accessible to balloon-borne detectors (energies greater than 20 keV) can be explained by assuming them to be caused by the eclipsing properties of a binary system. It is suggested that the system is composed of a source of small angular extent having a spectrum similar to that of a black body at approximately 1.5×10^8 K (kT = 12.5 keV) and a non-x-radiating companion that eclipses it at intervals of 2.9850 days. The system would be surrounded by an x-radiating plasma whose photon flux between 1 and 100 keV can be approximated by a power law spectrum whose exponent is –1.7. (auth)

32561 INTERSTELLAR SCATTERING OF PULSAR RADIATION AND ITS EFFECT ON THE SPECTRUM OF NP 0532. Cronyn, Willard M. (Environmental Science Services Administration Research Labs., Boulder, Colo.). Science; 168: 1453-5 (19 Jun 1970).

Angular scattering in the interstellar medium results in multipath dispersion that can amount to more than one pulse period for pulsars of short period and high-dispersion measure. The dispersion, if operative, imposes on the pulsation flux a cutoff inversely proportional to the fourth power of the observing wavelength. The low-frequency pulse shape of pulsar NP 0532 suggests that this pulsar is subject to such scattering and that the observed low-frequency cutoff in the apparent spectrum is not an intrinsic property of the pulsar. In fact, there is evidence that NP 0532 may be identified as the compact, low-frequency source in the

Crab Nebula and that the pulsar may radiate in accordance with its high-frequency spectrum down to frequencies as low as 10 MHz, although the periodic time variations are suppressed by the scattering below 100 MHz. (auth)

32562 DEVELOPMENTS IN THE THEORY OF THE SYNCHROTRON RADIATION AND ITS REABSORPTION. Ginzburg, V. L. Comments Astrophys. Space Phys.; 1: 49-56(Mar-Apr 1969).

During the last two or three years some important points in the theory of synchrotron radiation have been cleared up. A brief discussion is given on the following points: (a) Synchrotron radiation in the case of helical motion. (b) Synchrotron radiation and its reabsorption for emitters moving with relativistic velocities. (c) Reabsorption of synchrotron radiation taking into account the change of polarization and the influence of "cold" plasma. (d) Synchrotron radiation of protons. (e) The limits of the theory of incoherent synchrotron radiation and coherent emission mechanisms. (f) Investigation of the change of the magnetic field due to deceleration (particularly as a result of synchrotron energy losses) of the particles moving in this field. (W.D.M.)

32563 FREQUENCY OF PULSAR STARQUAKES. Smoluchowski, R. (Princeton Univ., N. J.). Phys. Rev. Lett.; 24: 923-5(20 Apr 1970).

A relationship between the frequency of the occurrence of starquakes on pulsars and the shear strength of the solid crust of these objects is derived assuming various mechanisms of damping of their rates of rotation. Tentative conclusions concerning the shear strength, the age, and the composition of the Crab and the Vela pulsars are made. (auth)

32564 OPTICAL IDENTIFICATIONS OF A COMPLETE SAMPLE OF FAINT RADIOSOURCES. Braccesi, A. (Laboratorio Nazionale di Radioastronomia, Bologna); Ficcara, A.; Formiggini, L.; Gandolfi, E.; Lari, C.; Padrielli, L.; Tomasi, P.; Fanti, C.; Fanti, R. Astron. Astrophys.; 6: 268-74(Jun 1970).

The radio and optical properties of 214 extragalactic radio sources are discussed. It is shown that the bulk of the unidentified sources is likely to be due to powerful radio galaxies. Their log S-log N slope implies a strong evolution, similar to the one found for the 3CR QSS's. On the other hand, the small slope for the QSS counts at the flux level seems to suggest, for them, a cutoff in the redshift, around 2.5. (auth)

32565 OBSERVATIONS OF RADIO RECOMBINATION LINES AT $\lambda = 18$ cm. Churchwell, E.; Edrich, J. (National Radio Astronomy Obervatory, Green Bank, W. Va.). Astron. Astrophys.; 6: 261-7(Jun 1970).

Measurements of radio recombination lines at $\lambda = 18$ cm are reported in six galactic H II regions. A test for systematic line broadening over that expected from Doppler broadening is made and found to be negligible in all H II regions considered except in Orion A, for which a comparison is made with Griem's (1967) theory of Stark broadening. It is shown that the "carbon" recombination line intensity is definitely frequency-dependent in Orion A and IC 1795, but the helium-to-hydrogen number density ratio is not frequency-dependent within the measuring accuracy. (auth)

32566 ON THE SENSITIVITY AND NEP IN COHERENT AND INCOHERENT DETECTION. Baudry, A. (Observatoire, Floirac, France). Astron. Astrophys.; 6: 325-6(Jun 1970).

This letter is a short comparison of coherent and incoherent detection based chiefly upon the approximate derivation of a radio noise equivalent power. (auth)

32567 RADIO ASTROPHYSICS. NONTHERMAL PROCESSES IN GALACTIC AND EXTRAGALACTIC SOURCES. Pacholczyk, A. G. A Series of Books in Astronomy and Astrophysics. San Francisco; W. H. Freeman and Company (1970). 288p. $13.00.

Designed for courses in radio astronomy for senior and graduate students, this book is a compact presentation of the physical processes, especially the nonthermal processes, believed to be responsible for the radiation of electromagnetic waves at radio frequencies from astronomical sources. The fundamental physics of radio astronomy is emphasized instead of observational results or current problems. There are appendices containing tables of special functions used in problems involving synchrotron radiation and an extensive list of surveys of discrete radio sources and of papers about their spectra and structure. (W.D.M.)

Solar Phenomena

Refer also to abstracts 32749 and 32753.

32568 (N-70-14569) LONG-RANGE SOLAR FLARE PREDICTION. Final Report, June 1968-August 1969. Blizard, J. B. (Denver Research Inst., Colo.). Oct 1969. Contract NAS8-21436. 177p. (NASA-CR-61316). CFSTI.

Statistical studies of solar cycles show a high correlation between solar perturbations and proton events. It is hypothesized that the motion of the Sun and planets about the center of mass of the solar system could trigger solar disturbances in unstable zones in the solar subphotosphere at active longitudes. The results of this study indicate that many of the major recorded proton events occurred near major planet conjunctions. (auth) (STAR)

32569 COUPLING OF RADIATIVE TRANSFER AND THERMAL CONDUCTIVITY IN THE SOLAR CHROMOSPHERE. Frisch, Helene (Observatoire de Paris, Meudon, France). Compt. Rend., Ser. B; 270: 918-21(6 Apr 1970). (In French).

The influence of radiative energy transfer on the temperature distribution of a plane layer heated by conduction is studied. In some cases, the internal temperature may reach values much lower than those of limiting surfaces. Applications to the rising of temperature in the chromosphere are considered. (France)

32570 TWO NEW METHODS OF CALCULATING THE TEMPERATURE AND DENSITY OF THE CORONAL CONDENSATIONS OBSERVED AT METRIC WAVE LENGTH AND IN WHITE LIGHT. Leblanc, Yolande (Observatoire de Paris, Meudon, France). Compt. Rend., Ser. B; 270: 922-5(6 Apr 1970). (In French).

Two methods are developed to calculate the temperature and electron density of the coronal condensations. The results obtained are in good agreement with each other. The average temperature of the condensation is 1.8×10^6 °K and the density is two or four times as high as it is in the quiet corona. (France)

32571 EQUILIBRIUM ANISOTROPY IN THE FLUX OF 10-MeV SOLAR FLARE PARTICLES AND THEIR CONVECTION IN THE SOLAR WIND. Forman, Miriam A. (State Univ. of New York, Stony Brook). Contract NAS-2-3793. J. Geophys. Res.; 75: 3147-53(1 Jun 1970).

The portion of an anisotropy, in the flux of cosmic rays in the interplanetary medium, that arises from the motion of the solar wind plasma is in the same direction as the flow of the solar wind and is not perpendicular to the interplanetary magnetic field. The amplitude of this convective component of anisotropy is given by the Compton-Getting formula $(2 + \alpha\gamma)V/v$. The convective component was calculated for seven events during which the equilibrium anisotropy was observed in the flux of 7.5- to 45-MeV solar flare particles and it accounted for all (in four cases) or most of the anisotropy. From this it is concluded that, when the equilibrium anisotropy is observed, low-energy solar-flare particles are being transported mainly by convection in the solar wind. The ~14-hour decay time for the particle density, calculated by assuming only convective transport and adiabatic deceleration in a spherically expanding solar wind, is in reasonable agreement with observed values. The diffusive component of anisotropy is toward the Sun in one event, thus implying a positive particle density gradient. Convective transport can produce a positive particle density gradient late in a flare event, but diffusive transport alone cannot. The diffusive transport velocity appears to be so small in some cases that the Alfvén velocities of the magnetic irregularities that scatter particles may affect the scattering theory. (auth)

32572 POTENTIAL DISTRIBUTION SURROUNDING A PHOTO-EMITTING PLATE IN A DILUTE PLASMA. Guernsey, Ralph L.; Fu, Jerry H. M. (Univ. of Maryland, College Park). J. Geophys. Res.; 75: 3193-9(1 Jun 1970).

The potential distribution in the neighborhood of a photo-emitting plate immersed in a plasma is calculated, and it is found that two steady-state potential distributions can exist. In one the potential decreases from its plate value to zero monotonically, and in the other it decreases from its plate value to a (negative) minimum and then increases slowly to zero. This second "over-shoot" potential appears to be the stable one. Such over-shoot effects are expected to play an important role for sheaths around satellites in the interplanetary plasma. (auth)

32573 FRACTIONATION OF IRON: A COSMOGONIC SLEUTHING TOOL. II. HEATING BY ELECTRICAL INDUCTION. Sonett, C. P. (Ames Research Center, Moffett Field, Calif.). Comments Astrophys. Space Phys.; 1: 41-8(Mar-Apr 1969).

A model is presented that is based upon a Sun presumed to possess a T-Tauri type of gas outflow. The gas is highly ionized and convects outward a magnetic field strongly wound up in the classical Parker manner by rapid rotation of the Sun. To melt an asteroid of some 100 to 200 km radius it is required that energy be supplied at a rate of about 4×10^{-4} joules/gram-year. Two electromagnetic means of delivering the required flux of energy are considered. The method discussed first is unipolar induction which involves a steady-state theory, whereas the second, given more sketchily, uses eddy-current excitation. (W.D.M.)

32574 HYDROMAGNETIC ASPECTS OF SOLAR WIND FLOW PAST THE MOON. Spreiter, John R. (Stanford Univ., Calif.); Marsh, M. Clive; Summers, Audrey L. Cosmic Electrodyn.; 1: 5-50(Apr 1970).

Data from Explorer 35 showing the presence of a plasma-free cavity behind the Moon, often with a slightly enhanced magnetic field, and the lack of a bow-wave upstream of the Moon are used to establish an idealized mathematical model for the interaction of the solar wind with the Moon. In this model, the Moon is considered to be a perfect insulator that absorbs or electrically neutralizes the particles of the solar wind on contact, and the dynamics of the solar plasma flow is represented by the equations of continuum magnetohydrodynamics. The special case in which the interplanetary magnetic field is aligned with the flow direction is treated in detail and shown to lead to the concept of an elongated magnetic tail of the Moon. Exact numerical results for the density, velocity, temperature, and magnetic fields throughout the region influenced by the Moon are presented for representative conditions in the incident solar wind. These results are shown to be in accordance with observations at times when the interplanetary magnetic field is approximately aligned with the direction of flow. A semiquantitative analysis of the properties of solutions to be anticipated for other alignments of the interplanetary magnetic field is also included. It indicates that the wake of the Moon terminates within a few lunar radii of the Moon whenever the angle between the interplanetary magnetic field and the solar wind direction exceeds about 10 to 20°, and that the wake develops an oval cross section as it tapers down to a wedge-like rather than conical closing. The results are used to account for several features of the data obtained by the magnetometers and plasma probe on Explorer 35. (auth)

32575 SOLAR WIND PROBLEM WITH FLUCTUATIONS. Siscoe, G. (Massachusetts Inst. of Tech., Cambridge). Cosmic Electrodyn.; 1: 51-66(Apr 1970).

The conservation equations appropriate to the solar-wind problem are integrated over spherical volumes centered on the Sun. There results a set of five equations for spherical surface averages of the various solar-wind energies and certain covariances. The equations are used to indicate qualitatively the effect of fluctuations on the averaged quantities whose behavior is known in the case of no fluctuations from previous calculations. An equation is also given which governs the coupling between energies of fluctuations in regions of hypersonic solar-wind flow. One application of this formula shows that if the energies in fluctuations are equipartitioned, the radial dependence of the energies is of the form $r^{-\alpha}$, where $\alpha \approx 3$. The exact value depends on which energies are included in the equipartition. (auth)

32576 A STUDY OF MONOCHROMATIC IMAGES OF SOLAR PROMINENCES IN THE LIGHT OF He I D 3 AND He II 4686 LINES. Kubota, J.; Leroy, J. L. (Observatoire, Pic-du-Midi, France). Astron. Astrophys.; 6: 275-87(Jun 1970).

Monochromatic observations of prominences in the light of He II 4686 Å and He I D3 were performed with a coronagraph and filter systems at the Pic-du-Midi Observatory. Five sets of monochromatic images (D3 and 4686 Å) of quiescent prominences were studied in detail. The contamination in 4686 images of continuum light emitted from the prominence was taken into account. The comparison of the isophotes of 4686 light with those of D3 shows the similarity of distributions at both wavelengths in the main part of prominences within the range of errors due to the measurements and to the atmospheric agitation. In most cases, the ratio of intensities I (4686)/I (D3) is larger in the uppermost region and the "tail" than in the rest, and these regions seem to be interacting with neighboring coronal regions or other prominences. The 4686 emission has no relation to the 6374 emission in these prominences. The observations of faint Hα-emitting regions in the corona will give useful information for the study of the condensing process of coronal matter into a prominence. (auth)

32577 EVALUATION OF THE ELECTRIC CURRENT IN A SUNSPOT BY THE STUDY OF THE OBSERVED TRANSVERSE COMPONENT OF THE MAGNETIC FIELD. Rayrole, J.; Semel, M. (Observatoire de Paris, Meudon, France). Astron. Astrophys.; 6: 288-93(Jun 1970).

The method employed for the evaluation of electric current seems to give significant values. The analysis of these results leads to arguments unfavorable for a force-free model. At a certain point, a direct estimation of the Lorentz force is made. Finally, the difficulties and errors in the reduction of the data are discussed. (auth)

32578 SOLAR WIND MODELS BASED ON EXOSPHERIC THEORY. Jockers, K. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Astron. Astrophys.; 6: 219-39(Jun 1970).

Due to rare collisions, exospheric theory should be well suited to describe the solar wind. Nevertheless, according to the work of Chamberlain, it was thought that evaporation of particles cannot lead to the transonic flow present in the solar wind. Chamberlain assumed the radial electric field to be equal to that in a static atmosphere. However, the radial electric field has to be determined self-consistently by the quasi-neutrality condition. Then one can construct transonic solutions, even if the particles are collisionless. In the models, the spherically symmetric outflow of an electron–proton plasma is considered in which the protons are collisionless. In one model the electrons are also assumed to be collisionless, while in some others an isotropic electron temperature was explicitly prescribed. From comparison of the models with observation, one can draw the following conclusions about the real solar wind: (1) while in the quiescent solar wind nonthermal heating of the protons may not be present, it seems probable that wave–particle interactions or other nonstationary effects lead to a fluid-like behavior of the electrons even at quiet conditions; and (2) the observed fact that the protons have a lower velocity dispersion in the solar than in the antisolar direction is caused by a truncation of the distribution function because of the evaporation of the particles in the gravitational field. (auth)

32579 EXCITATION OF LITHIUM-LIKE IONS BY ELECTRON IMPACTS. III. TRANSITIONS 2p → ns, 2p → np AND 2p → nd. Bely, O.; Petrini, D. (Observatoire, Nice). Astron. Astrophys.; 6: 318-21(Jun 1970).

Coulomb–Born calculations were performed for the transitions 2p → 3l, 2p → 4l, and 2p → 7l (l = 0, 1, 2) for Be II, N V, Ne VIII, and the limiting hydrogenic case Z = ∞. Graphs are given which enable one to obtain the cross section 2p → nl (l = 0, 1, 2) for any n and any lithium-like ion. The results are discussed. (auth)

32580 STATISTICAL ANALYSIS OF SOLAR COSMIC-RAY PROTON FLUXES. Yucker, W. R. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). Trans. Amer. Nucl. Soc.; 13: 412-13(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32581 PHOTON LEAKAGE FROM THE MOON DUE TO SOLAR-FLARE BOMBARDMENT. Armstrong, T. W.; Alsmiller, R. G. Jr.; Moran, H. S. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 413-14(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32582 WATER VAPOUR IN SUNSPOTS. Mallia, E. A.; Blackwell, D. E.; Pitford, A. D. (Oxford Univ.). Nature (London); 226: 735-7(23 May 1970).

Features attributable to the water vapor molecule have been detected in the spectra of many stars, and evidence is presented for the existence of such molecules in sunspots. A sunspot spectrum in the region of 5880 Å, obtained Nov. 18, 1969 with the rapid-scanning photoelectric spectrometer at the Gornergrat Observatory of Oxford University, in Switzerland, is shown, together with the corresponding spectrum of the adjacent photosphere observed as a comparison. A sunspot spectrum was also obtained Jan. 20, 1970 in the region of 9300 Å, where both photospheric and sunspot spectra are simpler. Most of the lines are rotational in the 201 vibrational band of HOH. In order to obtain the true sunspot spectrum (intrinsic) that would be observed outside the Earth's atmosphere, correction must be made for absorption by water vapor in the Earth's atmosphere; the means for doing this are described. It was evident from a comparison of the photospheric and corrected sunspot spectra that all the principal HOH lines were enhanced in the spot spectrum. The enhancement was not the same for all lines, those nearer the band head being the more enhanced. The J-value corresponding to maximum intensity was higher in the sunspot spectrum than in the photospheric spectrum, providing additional evidence that the enhanced absorption in the HOH lines originates in the spot. Some support for this is also provided by the observed red shift between photospheric and intrinsic HOH lines; this shift is higher than 47 mÅ, which would result from the Doppler effect arising from the rotation of the Sun. A further scan of the same spectral region was made on Jan. 28, 1970, when the water vapor content of the Earth's atmosphere was considerably higher than on Jan. 29. Even under those conditions the observed sunspot lines were deeper than the photospheric lines, but the spectrum was much noisier, confirming that an extremely dry atmosphere is necessary for the determination of the amount of water vapor in sunspots. (UK)

32583 RADIATION OF PLASMA WAVES BY AN ELECTRON STREAM IN THE SOLAR CORONA. Yip, W. K. (Univ. of Tasmania, Sandy Bay, Australia). Aust. J. Phys.; 23: 161-76 (Apr 1970).

The radiation of plasma waves by an electron stream moving in the active solar corona is investigated with the dispersion taken into account. The angular and frequency spectra radiated by a single electron and the rate of growth for the plasma wave in the stream-plasma system are obtained. The expressions obtained are studied numerically with parameters appropriate to the active solar coronal region. (Australia)

Galaxies

32584 NEW INTERACTION BETWEEN GALAXIES AND STARS OF THE ELECTROMAGNETIC TYPE. Kalitsin, Nikola St. Izv. Sekts. Astron., Bulg. Akad. Nauk.; 3: 19-36 (1969).

Connecting links (bridges, tails, etc.) formed by stars are observed in the case of interacting galaxies. These interactions of the galaxies are explained by electrostatic and magnetic forces. It is shown that the observed peculiarities of the groups of galaxies and within the individual galaxies may be explained by these forces. (Abstr. Bulg. Sci. Lit.)

32585 CORRELATION BETWEEN THE MEAN MAJOR DIAMETERS OF SOME GALAXIES AND THEIR B(0) MAGNITUDES. Kalinkov, Marin; Cholakova, Nedka. Izv. Sekts. Astron., Bulg. Akad. Nauk.; 3: 77-85(1969).

The regressions between lg 0 and B(0) for the galaxies E0–E6 and L were determined on the basis of an entry in the catalog of Vaucouleurs. The significant (95%) boundaries of the parabolic regression in the examination of all elliptical galaxies were also determined. (Abstr. Bulg. Sci. Lit.)

32586 COMPARISON OF OBSERVED AND RANDOM DISTRIBUTION OF GALAXY COUNTS. Kalinkov, Marin; Veleva, Bojka. Izv. Sekts. Astron., Bulg. Akad. Nauk.; 3: 87-97(1969).

On the basis of the data obtained by counting the galaxies on a copy of the Palomar atlas, a check was made on the random distribution of the number of galaxies in equal squares. A theoretical model, based on three assumptions, is examined: (1) clusters of galaxies (of the 1st, 2nd, and further orders) do not exist; (2) the spatial density of the galaxies is constant; and (3) selection effects are absent. The check shows that assumption (1), as well as assumption (2) associated with it, is not in agreement with the observed distribution of the galaxies. (Abstr. Bulg. Sci. Lit.)

32587 N GALAXIES AS A METAGALACTIC POPULATION. Komberg, B. V. (Inst. of Applied Mathematics, Moscow); Ozernoi, L. M. Astrophys. Space Sci.; 7: 31-53(Apr 1970).

Optical and radio data about N galaxies (NG) as known at present are summarized and compared with the corresponding data about Seyfert galaxies (SyG), blue compact galaxies (BCG) and quasi-stellar objects (QSG and QSS). Information about normal galaxies and Haro and Markaryan objects is also utilized. The luminosity functions of different sources in the optical- and radio-ranges are constructed, based on the observational facts. Along with some general properties of NG and SyG, BCG, QSS, and QSG, a number of differences between these objects are noted. In particular UBV colors of NG and SyG change inside ring diaphragms for various diaphragm radii in quite different manners. Taking into account all these differences, it is concluded that N-galaxies are neither distant SyG nor QSS at small distances and therefore relatively weak, but are the representatives of a different metagalactic population. Arguments about the existence of stars in N-galaxies as well as a central source of nonstellar nature are discussed. The question of possible evolutionary relations among the sequence of metagalactic populations Ir-S-E-D-(BCG-NG)-(QSG-QSS) is touched upon briefly. (auth)

32588 FREE-ELECTRON CONCENTRATION IN H I REGIONS OF THE GALAXY. Rees, M. J.; Sciama, D. W. (Cambridge Univ., Eng.). Comments Astrophys. Space Phys.; 1: 35-40 (Mar-Apr 1969).

The discovery that the radio emission from pulsars shows a well-defined dispersion has aroused new interest in the free-electron concentration in H I regions and in the processes which produce these free electrons. The ionization processes are discussed and the column densities in the direction of pulsars are considered. (W.D.M.)

32589 INTERSTELLAR CLOUDS. Field, George B. (Univ. of California, Berkeley). Comments Astrophys. Space Phys.; 1: 107-15(May-Jun 1969).

Interstellar matter is clumped into dense clouds, with relatively low density in between. The equilibrium of individual clouds is considered and a discussion is given on surface pressure or an excess of surface magnetic stresses over magnetic energy. (W.D.M.)

32590 PROSPECTS FOR NUCLEAR GAMMA-RAY ASTRONOMY. Clayton, Donald D.; Fowler, William A. (California Inst. of Tech., Pasadena). Comments Astrophys. Space Phys.; 1: 147-52(Jul-Aug 1969).

The implications of detecting nuclear gamma-ray lines from radioactive species in expanding supernova envelopes for the study of galactic nucleosynthesis are considered. The evidence obtainable from gamma-ray astronomy can help solve some of the most perplexing problems that exist in an interpretation of galactic evolution. (W.D.M.)

32591 POLARIZATION MEASUREMENTS AND MAGNETIC FIELD STRUCTURE WITHIN THE MAGELLANIC CLOUDS. Schmidt, Th. (Max-Planck-Institut fuer Astronomie and Landessternwarte, Heidelberg). Astron. Astrophys.; 6: 294-308(Jun 1970).

Photoelectric surface polarimetry of both Magellanic Clouds was carried out at the Boyden Observatory, South Africa. A 50-cm Cassegrain reflector equipped with a digital photoelectric polarimeter was used. The procedures of reduction are discussed in some detail, including the correction against polarizing foreground effects. The results are plotted together with single-star polarization measurements and numerical values are given. A discrepancy between polarization angles of a single star and surface measurements within the LMC "bar" may be explained by high-albedo interstellar dust containing two layers of different star densities and different magnetic field directions. The surface polarization angles in both clouds are predominantly aligned parallel to the LMC–SMC connecting great circle, from which the existence of a general magnetic field is obvious, connecting both clouds and indicating a common origin of the entire "Panmagellanic System." Rough upper and lower limits of magnetic field strengths may be derived from the dispersion of polarization angles within the 30 Dor constellation and from the kinetic energy content of the Magellanic Clouds gas components. Although these limits are of restricted accuracy only, the corresponding Panmagellanic magnetic energy content in every case is too high to be generated by the kinetic energy at present available from Magellanic Cloud gas components. (auth)

32592 MODEL FOR THE EARLY EVOLUTION OF GALAXIES. Brosche, P. (Astronomisches Rechen-Institut, Heidelberg). Astron. Astrophys.; 6: 240-53(Jun 1970).

It is assumed that a protogalaxy consists of several clouds whose position and velocity vectors have no preferred direction. A most probable statistical angular momentum follows from this. The galaxy loses energy through cloud collisions and therefore shrinks. This process is quasi-stationary, the virial theorem being thus constantly applicable. For a simple model (a sequence of rigidly rotating homogeneous spheroids) all the characteristic quantities, including the collision time determining the time dependence of evolution follow from the virial theorem in tensor form and from the conservation of angular momentum. Stellar formation occurs with increasing density of the gas. (W.D.M.)

32593 THE HYDROGEN CONTENT AND KINEMATICS OF MESSIER 51. Roberts, M. S.; Warren, J. L. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astron. Astrophys.; 6: 165-72(Jun 1970).

NGC 5194/5 was observed in the 21-cm hydrogen line with the 300-foot and 140-foot telescopes at the National Radio Astronomy Observatory. For an adopted distance of 4Mpc, an H I mass $9.2 \times 10^8 M_\odot$ is obtained. This hydrogen is associated with M 51 through its distribution and motions. Little H I is found in NGC 5195. The total mass calculated for M 51 is $1.6 \times 10^{10} M_\odot$. A model-fitting technique was used to estimate the position angle and systemic velocity of M 51 and the parameters describing a rotation curve of the Brandt form. The H I results are compared with optical studies of the luminosity distribution and the kinematics of M 51. The motion of NGC 5195 with respect to M 51 is discussed briefly. (auth)

32594 EXTENSION OF THE 408-MHz SOUTHERN MILKY WAY SURVEY AND ASSIGNMENT OF AN ABSOLUTE BASE LEVEL. Price, R. M. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Aust. J. Phys.; 23: 227-8(Apr 1970).

A radio contour map of the region near the galactic center, obtained at 408 MHz, is given. (Australia)

Cosmology

32595 SMALL-SCALE FLUCTUATIONS OF RELIC RADIATION. Sunyaev, R. A.; Zeldovich, Ya. B. (Inst. of Applied Mathematics, Moscow). Astrophys. Space Sci.; 7: 3-19 (Apr 1970).

Perturbations of the matter density in a homogeneous and isotropic cosmological model which leads to the formation of galaxies should, at later stages of evolution, cause spatial fluctuations of relic radiation. Silk assumed that an adiabatic connection existed between the density perturbations at the moment of recombination of the initial plasma and fluctuations of the observed temperature of radiation $\delta T/T = \delta\rho_m/3\rho_m$. It is shown that such a simple connection is not applicable due to: (1) The long time of recombination; (2) The fact that when regions with $M < 10^{15}\ M_\odot$ become transparent for radiation, the optical depth to the observer is still large due to Thompson scattering; (3) The spasmodic increase of $\delta\rho_m/\rho_m$ in recombination. As a result the expected temperature fluctuations of relic radiation should be smaller than adiabatic fluctuations. The value of $\delta T/T$ arising from scattering of radiation on moving electrons is calculated; the velocity field is generated by adiabatic or entropy density perturbations. Fluctuations of the relic radiation due to secondary heating of the intergalactic gas are also estimated. A detailed investigation of the spectrum of fluctuations may, in principle, lead to an understanding of the nature of initial density perturbations since a distinct periodic dependence of the spectral density of perturbations on wavelength (mass) is peculiar to adiabatic perturbations. Practical observations are quite difficult due to the smallness of the effects and the presence of fluctuations connected with discrete sources of radio emission. (auth)

32596 THE INTERACTION OF MATTER AND RADIATION IN THE HOT MODEL OF THE UNIVERSE. II. Sunyaev, R. A.; Zeldovich, Ya. B. (Inst. of Applied Mathematics, Moscow). Astrophys. Space Sci.; 7: 20-30(Apr 1970).

Heating of the primeval plasma prior to the epoch of recombination results in distortions in the Rayleigh–Jeans region of the microwave relic radiation spectrum ($\lambda \sim 1$-60 cm, or more exactly $\lambda = 2.5\Omega^{-1}$cm). The present observational data allow limits to be set to such energy injection from which follow upper limits to (a) the amount of antimatter in the universe; (b) the parameters of primeval turbulence; and (c) the adiabatic fluctuation spectrum for small masses ($M < 10^{11}\ M_\odot$). If the heating takes place prior to the epoch $t = 10^{10}\Omega^{-1/4}$ sec (and in particular at the annihilation of electron–positron pairs at $T \sim 10^9 - 10^{10}$K, $t < 300$ sec), no observable distortions are expected in the relic radiation spectrum. Here $\Omega = \rho/\rho_{crit}$ is the dimensionless average density of matter in the Universe. (auth)

32597 LUKEWARM MODELS OF THE INTERGALACTIC MEDIUM. Mendis, D. Asoka; Axford, W. I. (Univ. of California, San Diego, La Jolla). Astrophys. Space Sci.; 7: 160-73(Apr 1970).

The physical state of a moderately dense, uniform, pure hydrogen medium, pervading the metagalaxy and partaking in the general cosmic expansion, is considered. The cosmic x-ray photon spectrum, which is now observed down to about 0.25 keV, together with various plausible extrapolations down to the Lyman limit, is invoked as the source of ionization and heating of this medium. Isothermal and adiabatic modes of expansion of the intergalactic medium are studied as limiting cases of the present mode of expansion. The isothermal mode generates highly ionized but "lukewarm" ($7700\ K \leq T \leq 25000\ K$) models of the medium, with the so far unknown turnover point in the cosmic x-ray spectrum as the parameter required to fix the temperature and degree of ionization uniquely, for any assumed value of the present density. The adiabatic mode, while giving rise to high degrees of ionization, also produces significantly higher temperatures which are independent of density and always greater than about 28000 K. In conclusion, a possible explanation for the anomalous 3C 9 result is adduced. (auth)

32598 "MIXMASTER UNIVERSE" AND THE COLD VARIANT. Zel'dovich, Ya. B. (Inst. of Applied Mathematics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 11: 197-9(20 Mar 1970).

Translated from Zh. Eksp. Teor. Fiz.; Pis'ma Red.; 11: 300-3 (20 Mar 1970).

Recently Misner (1969) raised the question of a cosmological model in which the observed isotropy of the Universe might have a natural explanation. This question is considered and attention is directed to entropy perturbations. These are defined as perturbations of the ratio $s = \gamma/f$ of the density of the quanta $\gamma \sim T^3$ to the density of the baryon charge $b = B - \bar{B}$, where s is the dimensionless entropy, T is the temperature, B is the baryon density, and $\bar{B}$ is the anti-baryon density. (W.D.M.)

32599 TURBULENCE IN AN ISOTROPIC UNIVERSE. Chernin, A. D. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 11: 210-12(20 Mar 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 317-19(20 Mar 1970).

It is shown that the state of developed metagalactic turbulence need not necessarily be "primordial"; it could arise during the period of recombination of the cosmic plasma, owing to small motions of a potential or an acoustic type. These motions, unlike vortical motions, are compatible with the isotropy of the metric in all the phases of expansion. (W.D.M.)

32600 EFFICIENCY OF ENERGY RELEASE IN GRAVITATIONAL COLLAPSE. Dyson, Freeman J. (Inst. for Advanced Study, Princeton, N. J.). Comments Astrophys. Space Phys.; 1: 75-80(May-Jun 1969).

Gravitational forces remain attractive at all distances, and their strength increases monotonically with density. There is no obvious reason why a mass M collapsing gravitationally into itself should not release an amount of energy $\epsilon_g Mc^2$ with ϵ_g arbitrarily close to unity. It has been suggested that collapse with $\epsilon_g \approx 1$ might be occurring in radio galaxies and quasars. This raised the question, "what is the theoretical upper limit to the efficiency ϵ_g of gravitational energy release?" The purpose of this article is to summarize the little that is known about ϵ_g, and to suggest some ways in which a better understanding may be reached. (W.D.M.)

32601 SUPERFLUIDITY AND SUPERCONDUCTIVITY IN ASTROPHYSICS. Ginzburg, V. L. Comments Astrophys. Space Phys.; 1: 81-6(May-Jun 1969).

The natural question about the existence of superconductivity and superfluidity in the Universe can be formulated in such a way: In cosmic conditions, is the existence of superfluid or superconductive states of new types or of new substances possible? Such a question has been discussed for several years and it is of interest not only theoretically but also for solving real astrophysical problems. This question is briefly clarified. (W.D.M.)

32602 COSMIC HELIUM. Burbidge, Geoffrey (Univ. of California, La Jolla). Comments Astrophys. Space Phys.; 1: 101-6(May-Jun 1969).

It is known that the He/H abundance in comparatively young systems like O and B stars, and gaseous nebulae, is of the order of 25 to 30% by mass. If this is characteristic of the bulk of the mass of the Galaxy, it is clear that this much helium could not have been synthesized by ordinary main-sequence stars with a luminosity function constant over 10^{10} years and similar to that existing today. The three possibilities which could account for this abundance are discussed. (W.D.M.)

32603 EVOLUTION OF DENSITY FLUCTUATIONS IN THE UNIVERSE. I. DISSIPATIVE PROCESSES IN THE EARLY STAGES. Rees, M. J.; Sciama, D. W. (Cambridge Univ., Eng.). Comments Astrophys. Space Phys.; 1: 140-6(Jul-Aug 1969).

The significance of the discovery of the microwave background radiation to cosmology is discussed, and current ideas on the behavior of inhomogeneities during the early history of the primordial fireball are reviewed. (W.D.M.)

32604 RELATIVISTIC FLUIDS IN COSMOLOGY. Misner, Charles W. (Univ. of Maryland, College Park). pp 117-20 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

The discussion of relativistic fluids in cosmology covers chaotic cosmology, in which three main theoretical problems are considered. These are the formulation of statistical methods of describing the initial data near the singularity, the understanding of the nature of horizons in irregular expanding universes, and the proof of the cosmological principle. (J.F.P.)

32605 RELATIVISTIC STAR CLUSTERS. Fackerell, Edward D.; Ipser, James R.; Thorne, Kip S. (California Inst. of Tech., Pasadena). Comments Astrophys. Space Phys.; 1: 134-9(Jul-Aug 1969).

Relativistic star clusters are defined to be a cluster so dense that general-relativistic effects (gravitational redshift and onset of relativistic gravitational collapse) play important roles in its structure and evolution. An attempt is made to provide answers to the following three questions: Under what conditions are relativistic effects important for a star cluster? Is there any reason to believe that relativistic star clusters might exist in quasars or in nuclei of some galaxies? Assuming that relativistic star clusters might exist somewhere in the Universe, what should be their properties? (W.D.M.)

32606 DYNAMICS OF SO(3,R)-HOMOGENEOUS COSMOLOGIES. Matzner, Richard A.; Shepley, L. C.; Warren, James B. (Univ. of Texas, Austin). Contracts AT(11-1)-34; F33615-68-C-1675. Ann. Phys. (N. Y.); 57: 401-60(Apr 1970).

Cosmologies having spacelike 3-dimensional homogeneity surfaces on which the group of motions is SO(3,R) (Bianchi Type IX)

are investigated. These models generalize the ordinary "closed" Robertson–Walker models. Detailed analytical and numerical treatment is given for those models containing pressureless fluid (dust). Included are proofs that infinite density regions and a time of maximum expansion occur in each model. Extensive discussion is devoted to the evolution of anisotropy and the possibility of "mixing," a phenomenon characterized by the absence of a horizon in any direction. Numerical examples, illustrating the various types of models, are displayed graphically. (auth)

32607 MODEL CLASSIFICATION FOR RELATIVISTIC UNIVERSES CONTAINING MATTER AND RADIATION. Payne, A. D. (Univ. of Tasmania, Sandy Bay, Australia). Aust. J. Phys.; 23: 177-85(Apr 1970).

Relativistic world models containing both matter and radiation are classified by means of the cosmological constant λ and the density parameter σ_0. The properties of some model parameters are examined in relation to the temperature of the radiation field which is assumed to be Planckian. (Australia)

Planetary Phenomena

32608 COMPARATIVE CHARACTERISTICS OF THE IONOSPHERES OF THE PLANETS OF THE TERRESTRIAL GROUP: MARS, VENUS, AND THE EARTH. Gringauz, K. I.; Breus, T. K. (Radiotechnical Inst., Moscow). Space Sci. Rev.; 10: 743-69(Jun 1970).

A brief review is presented on the state of investigations of the ionospheres of planets of the terrestrial group. The following items are considered—the techniques of investigating planetary ionospheres, experimental results available and their interpretation, and comparison of these results. (W.D.M.)

32609 CHARACTERISTIC γ AND X RADIATION IN THE PLANETARY SYSTEM. Gorenstein, Paul; Gursky, Herbert (American Science and Engineering, Cambridge, Mass.). Space Sci. Rev.; 10: 770-829(June 1970).

The question of what can be expected in the way of determining chemical abundances from a vehicle in orbit around a planet that carries presently existing instrumentation for the detection of characteristic x and γ rays is considered. Remote sensing and passive observation is the framework of the measurement under consideration. Mechanisms for producing these characteristic lines are discussed and various estimates for the flux plus some experimental results that have appeared in the literature are described. (W.D.M.)

32610 ORIGIN OF THE MOON: THE PRECIPITATION HYPOTHESIS. Ringwood, A. E. (Australian National Univ., Canberra). Earth Planet. Sci. Lett.; 8: 131-40(Apr 1970).

The basaltic rocks returned by Apollo 11 were probably formed by a small degree of partial melting in the lunar interior. Their compositions overlap the terrestrial basalt ranges for most elements; however, there are important differences in the abundances of another group of elements and also in oxidation states. These similarities and differences are believed to be characteristic of the source regions of the lunar basalt and terrestrial basalts. In particular they demonstrate the occurrence of a fractionation between lunar and terrestrial mantles dominated by selective volatility of some elements. They are not readily explained by current versions of fission, binary planet, and capture hypotheses. It is therefore necessary to examine other theories of lunar origin. Öpik has argued that the Moon formed by coagulation of a terrestrial "sediment-ring" but did not explain the origin or composition of the latter. A possible explanation arises from an extension of the single-stage hypothesis for the origin of the Earth previously advanced by the author. This maintains that during the later stages of accretion of the Earth, a massive primitive atmosphere developed which was hot enough to selectively evaporate a substantial proportion of the silicates which were accreting upon the earth. Subsequently, the atmosphere was driven away by particle radiation from the Sun as it passed through a T-Tauri phase. The relatively nonvolatile silicate components were precipitated close to the Earth to form a swarm of planetesimals or moonlets, as the atmosphere was dissipated and the moon accreted from these chemically fractionated planetesimals. The more volatile components of the terrestrial atmosphere were precipitated at lower temperatures, further from the Earth, as fine smoke particles and were lost from the Earth–Moon system with the escaping gases. The hypothesis appears capable of explaining the low density of the Moon, the inferred fractionation of relatively volatile elements between Earth and Moon, and the different oxidation states of the terrestrial and lunar mantles. The above "precipitation" hypothesis thus implies a close genetic relationship between earth and moon. The precipitation and fission hypotheses are also closely connected since the material now in the Moon is regarded as having been derived ultimately from the Earth—not from the solid mantle, but from the massive primitive terrestrial atmosphere. (auth)

Atomic and Molecular Physics

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstract 32831.

32611 ENERGY LOSS OF HEAVY CHARGED PARTICLES. Walsh, Phillip J.; Underwood, Newton (Univ. of North Carolina, Chapel Hill). Health Phys.; 18: 561-5(May 1970).

Assuming a simple charge distribution of the form $\rho = \rho_0 \lambda r e^{-\lambda r}$ for the atoms of a stopping material, the atomic stopping cross sections of hydrogen, helium, carbon, and lithium for protons are calculated. The results for hydrogen agree with experimental data for proton energies as low as 35 keV and the results for lithium, helium, and carbon agree with experiment for proton energies as low as 100 keV. (auth) (UK)

32612 ANGULAR DISTRIBUTIONS OF K-SHELL PHOTOELECTRONS. Parthasaradhi, K.; Rama Rao, J. (Andhra Univ., Waltair, India). Indian J. Phys.; 43: 419-21(Jul 1969).

The angular distributions of K-shell photoelectrons from Pb, Pt, Ta, Sn, Rh, and Cu at gamma energies 84, 100, 129, 145, and 320 keV were calculated on the basis of Nagel's theory (Ark. Fys., 18: 1(1960)). Results show that photoelectrons are emitted from 0° to 180°. As the angle increases the intensity increases, reaches a maximum, and decreases gradually. The intensity also increases as the gamma energy decreases and as the atomic number increases. The angle of maximum intensity emission increases as the atomic number increases and gamma energy decreases. (A.G.W.)

32613 CHANGE OF $2S_{\frac{1}{2}}$ HFS OCCUPATION NUMBERS BY STATIC MAGNETIC FIELDS IN THE DEUTERIUM ATOMIC BEAM OF A LAMB-SHIFT SOURCE. Bechtold, V.; Brueckmann, H.; Finken, D.; Friedrich, L. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys.; 231: 98-108(1970). (In German).

Polarized deuteron beams may be obtained from metastable atomic beams by quenching three of the six hyperfine-structure levels. Using a field distribution that crosses zero on the beam axis the occupation numbers of the hyperfine-structure levels may be changed by a nonadiabatic process. The special conditions for this magnetic field are discussed by comparing the corresponding Larmor frequency of the metastable atoms with the angular frequency of the magnetic field vector. Experimental investigations were carried out for field gradients between 1.9 and 5.4 Oe/cm and for superposed homogeneous transverse fields of up to 6 Oe. With deuterons a tensor polarization of $P_{33} = -0.70 \pm 0.01$ was obtained at a negative ion beam current of 42 nA. (auth)

32614 NEW RANGE MEASUREMENT OF SWIFT ELECTRONS WITHOUT BREMSSTRAHLUNG EFFECT. Kato, Ryuhei; Ono, Ryoichi; Hasegawa, Takeo; Idzumi, Shotaro; Itatani, Norio (Ritumeikan Univ., Kyoto). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 57-9(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The experimental procedures to measure ranges without bremsstrahlung interference are as follows: (1) a uniform electron beam from a betatron, kept to fixed energy and intensity, is injected into an absorber, (2) a suitable electrode is attached to the absorber, and (3) the charge of the electrons is led to one terminal of a highly sensitive electrometer, the other terminal being grounded. Then, the electrons stopped in the absorber increase in number according to the increment of the absorber thickness. Even when the absorber thickness exceeds a certain value (saturated value), the indication of the electrometer does not rise further, since in this condition, all of the electrons should be perfectly stopped in the absorber. This thickness is regarded as the "true range" of the electrons. Because the samples used have both roles, one as absorber the other as detector, the net electrons are detected directly free from such secondary harmful effects as the bremsstrahlung in contrast with traditional methods. Results are given for 2.8- to 32-MeV electrons in aluminum, copper, lead, and water. (L.M.T.)

32615 GENERATION OF A LOW-ENERGY POSITRON BEAM. Lohnert, G. H.; Schneider, R. T.; Schikorr, W. M. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 13: 79-80(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32616 EIGENVALUES AND EIGENFUNCTIONS OF THE HYDROGEN MOLECULAR ION H_2^+ IN EXCITED STATES AND THE INGLIS–TELLER LIMITS OF THE HYDROGEN SERIES IN PLASMAS. Cho, Sang-jean. Lexington, Ky.; Univ. of Kentucky (1965). 92p.

Thesis.

The wave equation of the hydrogen molecule ion (H_2^+), expressed in a spheroidal coordinate system is briefly described. In this coordinate system the wave equation can be separated into three ordinary differential equations. Two of these differential equations have three term recursion formulas and thus must be studied via continued fractions. One of these two solutions, corresponding to the hyperboloidal family, has been tabulated by Stratton, Morse, Chu, et al., for orbital quantum number l, magnetic quantum number m, and a parameter $p^2 = -\frac{1}{4}R^2E$ (E is the electronic energy in Rydberg units) up to 8, and by Abramowitz for asymptotic cases. These tables yield the separation constants A. Knowledge of the separation constants reduces the study to the proper solutions of the ellipsoidal family. These are obtained by solving a continued-fraction equation. Such solutions yield the energy eigenvalues and the wave functions of various states as a function of the internuclear separation R. General procedures to obtain these solutions and the methods of numerical analysis employed are described. The results were obtained using IBM 7040 and 1410 computers. Eigenvalues and other appropriate numerical data are given. The expansion coefficients of the exact wave function for the ellip- family were tabulated here because of the limited space, but will be reproduced and made available to interested scientists. A discussion of the correlation between quantum numbers in the united atom notation, intermediate atom notation, and the separated atom notation is given. The results are used to discuss the Inglis–Teller Limit of the Lyman and Balmer series of hydrogen spectra in plasmas. This is a relationship between the charge number density N contributing to the spectral broadening and the principal quantum number n_m for the last resolvable spectral line. The original Inglis–Teller Limit is given by $\log N = 23.26 - 7.5 \log n_m$. Several authors (Jurgens, Niessen and others) have performed experiments with hydrogen plasmas in order to test the Inglis–Teller formula during the past several years. Because of the difficulties of such experiments, their experimental results are not unique and there is an experimental uncertainty of at least 20%. Also a number of authors (Griem, Barranger and Unsold) have tried to modify the Inglis–Teller Limit by considering electron broadening and a modified Holtzmark's distribution function. However they included only the first-order Stark effect as in the original work of Inglis and Teller. The results of this thesis show that the coefficient 7.5 in the Inglis–Teller formula should be decreased when the quantum number of the last resolvable line is not large. (Disser. Abstr. Int., B)

32617 SOME PECULIARITIES OF ANGULAR DISTRIBUTIONS IN BCC-METAL SPUTTERING. Dubinskii, V. E.; Lebedev, S. Ya. (Academy of Sciences, Moscow). Phys. Lett.; 31A: 533-4(18 May 1970).

Numerous new details of angular distribution of sputtered material in the bombardment of Ta and W single crystals by 70-keV Ar ions were obtained. (auth)

Atomic and Molecular Properties

Refer also to abstract 32829.

32618 CALCULATIONS ON AUTOIONIZATION OF THE $^4P_{\frac{5}{2}}^o$ STATE OF He^-. Estberg, G. N. (Univ. of San Diego, Calif.); LaBahn, R. W. Phys. Rev. Lett.; 24: 1265-7(8 Jun 1970).

The autoionization lifetime of the $^4P_{\frac{5}{2}}^o$ state of He^- is calculated using an accurate description of the initial- and final-state wave functions. In these calculations the initial $^4P_{\frac{5}{2}}^o$ state is represented by a variational wave function consisting of several angular configurations. The final $^2F_{\frac{7}{2}}^o$ continuum state is obtained by polarized-orbital theory. A lifetime of 4.55×10^{-4} sec is predicted, which is in good agreement with the most recent experimental measurement. (auth)

32619 LIFETIMES AND FINE STRUCTURE OF THE METASTABLE AUTOIONIZING $(1s2s2p)^4P$ STATES OF THE NEGATIVE HELIUM ION. Blau, L. M.; Novick, R.; Weinflash, D. (Columbia Univ., New York). Phys. Rev. Lett.; 24: 1268-72(8 Jun 1970).

The decay of the differentially metastable autoionizing $(1s2s2p)$ ^4P_J states of the $^4He^-$ ion was studied by time-of-flight techniques in an axial magnetic field, and Zeeman quenching was observed. Two distinct lifetime components (11 μsec, 210 μsec) were identified in a 100-eV beam with an axial field of 400 G. The zero-field lifetimes obtained from these and other measurements are 11 ± 5 μsec for $J = \frac{1}{2}, \frac{3}{2}$, and 345 ± 90 μsec for $J = \frac{5}{2}$. The $\frac{5}{2}-\frac{3}{2}$ fine-structure interval is estimated to be 0.050 ± 0.015 cm^{-1}. (auth)

32620 CONFIGURATION INTERACTION AND DISCOVERY OF A MISSING TERM IN NEUTRAL EUROPIUM. Smith, Geoffrey; Collins, Brian S. (Oxford Univ.). J. Opt. Soc. Amer.; 60: 866-7(Jun 1970).

Experimental identification of a previously missing ^8P term of the subconfiguration $4f^7(^8S)5d6p$ is reported. Its position is explained by considering configuration interactions with $4f^7(^8S)6s6p$. It is concluded that configuration interactions of the type described are likely to be extremely important in all neutral rare earth spectra. (A.G.W.)

32621 EXTENSION OF THE ANALYSIS OF SINGLY IONIZED GADOLINIUM. Spector, Nissan (Soreq Nuclear Research Centre, Yavne, Israel). J. Opt. Soc. Amer.; 60: 763-76(Jun 1970).

Energy levels belonging to a system of three newly identified configurations of singly ionized gadolinium are established. This system is obtained by adding to the ^7F term of the $4f^8$ core the 6s, 6p, and 5d electrons. The lowest level of this system, designated at $^9F_{6\frac{1}{2}}$ of $4f^8(^7F)6s$, lies 7992.31 cm^{-1} above the $4f^7(^8S)5d6s^{10}D_{2\frac{1}{2}}^o$ ground level. Transitions connecting the new system to the ground configuration strictly obey the selection rule $\Delta S_l = 0$, where S_l is the parent spin. Coupling calculations furnish the theoretical basis for this selection rule and explain the unusual intensity relations found experimentally in the infrared. Energy levels for the $4f^8(^7F)5d$ and $4f^8(^7F)6p$ are designated in L–S and J–J coupling, respectively. Best values for the radial parameters of $4f^8(^7F)6p$ are obtained by least-squares calculation, with an rms error of 197 cm^{-1}. About 300 lines are classified. (auth)

32622 TENSOR POLARIZABILITY OF THE HELIUM 2^3S_1 STATE. Drake, G. W. F. (Univ. of Windsor, Ont.). Phys. Rev. Lett.; 24: 765-7(6 Apr 1970).

A variational calculation is presented of the tensor polarizability of the helium 2^3S_1 state. The theoretical value $\alpha_t = (3.48 \pm 0.01) \times 10^{-3}$ a.u. lies within the error limits of recent experimental measurements. (auth)

32623 DISSOCIATION OF DIATOMIC MOLECULES FROM THE VIEWPOINT OF THE INTEGRAL HELLMANN–FEYNMAN FORMULA: H_2, LiH, AND Li_2. Marron, Michael T. (Univ. of Wisconsin, Madison. Johns Hopkins Univ., Baltimore). J. Chem. Phys.; 52: 3600-5(1 Apr 1970).

The integral Hellmann–Feynman formula is used to compute the dissociation energies of H_2, LiH, and Li_2. The derivation of the transition densities and the method of taking the limit of the transition densities as one of the nuclei is removed to infinity are discussed. The expression for the dissociation energy of LiH is examined in detail. While the results (except for H_2) are inaccurate, it is argued that the essential characteristics of the transition density are correctly determined and that the method provides a basis for the physical interpretation of the factors that contribute to the dissociation energy. (auth)

32624 INTEGRAL HELLMANN–FEYNMAN ANALYSIS OF THE BINDING ENERGY OF H_2 AND LiH USING ATOMIC REFERENCE STATES. Marron, Michael T. (Univ. of Wisconsin, Madison). J. Chem. Phys.; 52: 3606-10(1 Apr 1970).

The integral Hellmann–Feynman formula is applied to study the energy differences involved in the processes $He \rightarrow H_2 \rightarrow H^-$ and $Be \rightarrow LiH \rightarrow Li^-$. The energy differences are computed using single-determinant SCF wave functions to represent the states. The transition density is reduced to diagonal form by means of a corresponding orbital transformation and each term in the energy expressions for the $Be \rightarrow LiH \rightarrow Li^-$ process is given a physical interpretation in terms of classical electrostatic concepts. A qualitative discussion is given, which indicates a simple model might readily account for all factors contributing to the energy difference. (auth)

32625 POLARIZABILITY AND SECOND DIELECTRIC VIRIAL COEFFICIENT OF INTERACTING He ATOMS. Lim, Tiong-koon; Linder, Bruno; Kromhout, Robert A. (Florida State Univ., Tallahassee). J. Chem. Phys.; 52: 3831-5(1 Apr 1970).

The polarizability α of the pair of interacting He atoms was calculated by Hartree–Fock perturbation theory, both coupled and uncoupled. A basis of 16 Gaussians was used, eight centered on each atom. Good convergence was obtained in the region of overlap between one and six atomic units internuclear separation, R. Values of α for large separations were obtained by extrapolation using an R^{-6} dependence as predicted by previous long-range calculations. The effect of the interatomic interaction on the second dielectric virial coefficient was then calculated using the radial distribution function based on empirical Lennard-Jones

parameters. The results show that the effect of overlap and exchange does not sufficiently counteract the positive deviation caused by the van der Waals interaction to produce the substantial negative value as measured by Orcutt and Cole. (auth)

32626 EXACT TREATMENT OF THE LONG-RANGE DIPOLE–DIPOLE INTERACTION BETWEEN TWO HELIUM ATOMS. Alexander, Millard H. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys.; 52: 3354-7(1 Apr 1970).

A new expression for the long-range dipole–dipole interaction coefficient is presented in terms of a polarizability-like response function. Certain results of Schwartz are used to evaluate this coefficient in the case of the interaction between two helium atoms and, by careful error analysis, to set accurate error bounds to this quantity. A value of $C_6 = 1.4605 \pm 0.0025$ is obtained (auth)

32627 ISOTOPIC SHIFTS OF Nd I. Comaniciu, Nicolae (Institut de Physique Atomique, Bucharest). Rev. Roum. Phys.; 14: 603-8(1969). (In French).

The isotopic shifts among the isotope pairs of Nd were measured with respect to the following atomic rays: lambda = 5729, 5675, 5620, 4945, 4924, and 4897 Å. For this purpose a Fabry–Perot photoelectric spectrometer was used as well as enriched Nd isotopes excited in a Schueler arc. It was concluded that the experimental shifts can be explained by the presence of a mass effect and also a nuclear volume effect. (tr-auth)

32628 A SIMPLE CALCULATION CONCERNING ELECTRON SHAKE-OFF DURING INTERNAL CONVERSION. Seykora, E. J.; Waltner, A. W. (North Carolina State Univ., Raleigh). Amer. J. Phys.; 38: 542-4(Apr 1970).

An order-of-magnitude estimate for the probability of K-shell electron shake-off from internal conversion is derived. The sudden approximation method is used to calculate the transition probability for shake-off. The approximations used are tested in a calculation for shake-off probability during beta decay. (J.W.R.)

32629 EXTENSION OF THE FRANCK–CONDON PRINCIPLE TO NUCLEAR SPINS. APPLICATIONS. Cohen-Tannoudji, Claude. (Ecole Normale Superieure, Paris). Comments At. Mol. Phys.; 2: 24-9(Apr-May 1970).

The Franck–Condon principle extended to nuclear spins states that since nuclear moments are much smaller than electronic moments their direction remains unchanged, in several cases, while the electronic system undergoes rapid and important modifications. The following examples and applications of such a situation are discussed: (1) broad-line optical pumping of the odd isotopes of Hg, Cd, and Zn, (2) orientation by optical methods of ^{3}He nuclei, (3) a new method for orienting atomic excited states of ^{3}He, and (4) relaxation problems involved in collisions. (A.G.W.)

32630 RELATIVISTIC CALCULATION OF ATOMIC X-RAY TRANSITION RATES. Rosner, H. R.; Bhalla, C. P. (Kansas State Univ., Manhattan). Z. Phys.; 231: 347-56(1970).

The fully relativistic transition probabilities in atomic x-ray emission are calculated for a wide range of selected elements of the periodic table, from Z = 21 to 93. The treatment includes the effect of the retardation of the radiation field. The atomic model used is the self-consistent relativistic Hartree–Fock, with the Slater approximation for the exchange term. The formulas for EL and ML multipole transition rates are derived, and transition rates are calculated for all transitions to the K shell, L subshells, and M subshells. The contributions of all multipoles, as determined by the angular momentum and parity selection rules, are included in the present work. The calculated values of $(K\alpha_2/K\alpha_1)$, $(K\beta_1/K\alpha_1)$, $(K\beta_3/K\beta_1)$, and $(K\beta_2/K\beta_1)$ transition rates are in good agreement with the available experimental data. Rates for the forbidden (M1) $2s_{\frac{1}{2}} - 1s_{\frac{1}{2}}$ transitions are also presented. (auth)

32631 ADIABATIC CORRECTIONS TO LONG-RANGE BORN–OPPENHEIMER INTERATOMIC POTENTIALS. Pack, Russell T.; Hirschfelder, Joseph O. (Univ. of Wisconsin, Madison). J. Chem. Phys.; 52: 4198-4211(15 Apr 1970).

The rotationally coupled electronic equations of the previously derived "best adiabatic" (BA) approximation are solved variationally at large values of the internuclear distance. Adiabatic interatomic potentials result, which contain all first-order corrections to the Born–Oppenheimer approximation and change smoothly as the internuclear distance changes. The angular momenta smoothly couple and uncouple resolving difficulties of earlier treatments with corrections to the centrifugal potential. Selection rules for the long-range corrections to the Born–Oppenheimer (BO) approximation are given. And the long-range adiabatic potentials in H_2 and OH are calculated as examples. (auth)

32632 INFRARED LASER EMISSIONS IN RARE EARTH VAPORS. Cahuzac, Ph. (CNRS, Orsay, France). Phys. Lett.; 31A: 541-2(18 May 1970). (In French).

New pulsed laser action was observed in thulium and ytterbium vapors. Nineteen infrared laser lines have been obtained in samarium and europium vapors. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstract 31431.

32633 EFFECT OF DISLOCATIONS ON POSITRON ANNIHILATION IN METALS. Dekhtyar, I. Ya. (Inst. of Metal Physics, Kiev). Phys. Lett.; 31A: 546-7(18 May 1970).

The interconnection of dislocation effects on angular distribution of annihilative radiation and on the lifetime of positrons is discussed. The lifetime of positrons in a dislocation core is estimated. (auth)

32634 MUONIUM HYPERFINE STRUCTURE MEASUREMENTS AT VERY WEAK MAGNETIC FIELDS. Crane, Philippe Jr. New Haven; Yale Univ. (1969). 129p.

Thesis.

An accurate value of the muonium hyperfine structure interval is of interest because it can be used to test the application of quantum electrodynamics to the muon–electron system, or to determine accurate values for some of the fundamental constants. Measurements of the hfs and its density dependence at very weak magnetic field provide an independent test of the previous high-field results, and increase the precision of these results. Muonium resonances were observed for the first time using krypton as the target gas. The observed resonances were a superposition of the F $m_F = 1,1 \rightleftharpoons 0,0$ and $1,-1 \rightleftharpoons 0,0$ transitions at a magnetic field of about 10 mG where these transitions are unresolved. Measurements were made in argon at 62 and 32 atm and in krypton at 42 and 21 atm. The fractional pressure shift for muonium was determined to be $-4.07 \pm 0.25 \times 10^{-6}$/torr in argon and $-10.4 \pm 0.3 \times 10^{-6}$/torr in krypton. The value determined from the extrapolation to zero density for the muonium hyperfine structure interval is 4463.269 ± 0.042 MHz. Assuming that the theory is correct, one can determine either $\alpha^{-1} = 137.0367 \pm 0.0012$, or $^{\mu}\mu/\mu_p = 3.183314 \pm 0.000\,034$ from this measurement. (Diss. Abstr.)

32635 PIONIC AND MUONIC X RAYS IN LIQUID ^{4}He. Wetmore, Robert John. Williamsburg, Va.; Coll. of William and Mary (1969). 150p.

Thesis.

Negative pions and muons were stopped in a liquid helium scintillation counter and resulted in the formation of pionic and muonic ^{4}He atoms. Pionic and muonic x rays from these atoms were observed with a Si(Li) spectrometer. The energies and yields of the K-series x rays were measured. The natural linewidth of the pionic 1s level was also measured. From the observed energy of the π-K_α transition of 10.70 ± 0.05 keV, the nuclear force shift ΔE_{nucl} of the 1s level was measured and found to be in agreement with its value as predicted by existing theories. The measured value is $\Delta E_{nucl} = 80 \pm 50$ eV. The measured value of the natural linewidth of the 1s level of the pionic ^{4}He atom is $\Gamma_{nat} = 10^{+460}_{+10}$ eV. This value was found to be in disagreement with an Eckstein prediction of 400 ± 240 eV, but in satisfactory agreement with other theoretical predictions. The measured values of the absolute and relative x-ray yields are tabulated. (Diss. Abstr.)

32636 ANNIHILATION OF POSITRONS IN HELIUM, NEON, AND ARGON. Montgomery, R. E.; LaBahn, R. W. (Louisiana State Univ., Baton Rouge). Can. J. Phys.; 48: 1288-1303(1 Jun 1970).

The electric field dependences of the direct annihilation rates for positrons in helium, neon, and argon are calculated. This is done by using a systematic description of the scattering process. The momentum transfer and direct annihilation cross sections are calculated within the framework of the polarized-orbital method that has worked well for electron–atom scattering. The cross sections are then used in the appropriate diffusion equation to determine the experimentally observable annihilation rates appropriate to the exponential decay region of the spectrum. The resulting annihilation rates are found to be extremely sensitive to the low-energy behavior of the cross sections. Best agreement between calculated and experimental annihilation rates is obtained for helium where fairly rigorous calculations of the cross sections are available. Good agreement between theory and experiment for neon and argon is obtained only by making judicious choices for the components of the distortion included in the calculations. It is

thus concluded that the positron–atom scattering process is considerably more sensitive to the details of the mutual distortion interaction than is observed in the corresponding electron–atom collision process. (auth)

32637 POSITRON ANNIHILATION IN HELIUM AND THE SYSTEM OF e^+ He BOUND STATE. Wang, Cherng-maw; Ache, Hans J. (Virginia Polytechnic Inst., Blacksburg). J. Chem. Phys.; 52: 4023-6(15 Apr 1970).

Within the framework of the valence bond method, the system of e^+ He bound state was treated with a two-center problem approximation. The e^+ He bound state was found to have a binding energy of 5.03 eV at its equilibrium-positron–helium-nucleus distance, $R_e = 0.693$ Å. The ratio of the effective nuclear charges for the positron and for the helium nucleus ϵ was found to have a value of 0.63 at R_e. An attempt was made to compare the results of the present work with those of others. (auth)

32638 EFFECTIVE NUMBER OF SINGLET ANNIHILATION ELECTRONS FOR POSITRONIUM IN MOLECULAR LIQUIDS. Bisi, A.; Gambarini, G.; Zappa, L. (CNR, Milan). Nuovo Cim.; 67B: 75-83(11 May 1970).

The decay rate of orthopositronium was measured in degassed molecular liquids. It was found that each atom contributes to the pick-off quenching with an effective number of electrons in the singlet state that does not appear to be perceptibly affected by the structural properties of the molecules. This result is discussed in the framework of the free-volume model proposed by Brandt and co-workers. (auth)

Collision Phenomena

Refer also to abstract 32820.

32639 EFFECT OF THE ELECTRON BOUND-STATE STRUCTURE ON IONIZATION CROSS SECTIONS IN ATOMIC COLLISIONS. Senashenko, V. S.; Nikolaev, V. S.; Shafer, V. Yu. (Moscow State Univ.). Phys. Lett.; 31A: 565-6(18 May 1970).

The cross sections for 1s- and 2s-electron loss by various hydrogen-like ions colliding with H and He were calculated and compared. An exact expression is given for the square of the matrix elements of the 2s-electron transition to the continuum states. (auth)

32640 ELASTIC SCATTERING OF ELECTRONS BY HELIUM ATOMS. Khare, S. P.; Shobha, P. (Meerut Univ., India). Phys. Lett.; 31A: 571-2(18 May 1970).

Differential and total cross sections for the elastic scattering of electrons by helium atoms are obtained in the plane-wave approximation, including adiabatic and nonadiabatic distortions of the atom. The results are in fair agreement with experimental data and other sophisticated calculations. (auth)

32641 QUASI-POTENTIAL METHOD FOR THE ANALYSIS OF TOTAL CROSS SECTIONS IN ATOM–ATOM SCATTERING. Vollmer, G. (Institut fuer Theoretische Physik, Freiburg i. B.). Phys. Lett.; 31A: 575-6(18 May 1970).

Using a new simple ansatz, the quasi-potential method enables one to compute total elastic cross sections by explicit formulas for the parameters of the quasi potential and for the important terms of the phase function. (auth)

32642 ADIABATIC REPRESENTATION FOR THE EXCHANGE INELASTIC ELECTRON–ATOM AMPLITUDE. Janev, R. K. (Boris Kidric Inst. of Nuclear Sciences, Belgrade); Ob'edkov, V. D. Phys. Lett.; 31A: 578-9(18 May 1970).

The Born–Oppenheimer and the Ochkur exchange amplitudes are represented in the adiabatic basis. The nonuniqueness of the Ochkur amplitude is shown and discussed. (auth)

32643 OSCILLATORY STRUCTURE IN p–H CHARGE-TRANSFER CROSS SECTION. Dewangan, D. P.; Karmohapatro, S. B. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Lett.; 31A: 579-80(18 May 1970).

The cross section for p–H charge transfer calculated by the impact-parameter method as a function of proton energy shows oscillatory structure consisting of two cosine terms. (auth)

32644 ELECTRON–MOLECULE INTERACTIONS. I. SINGLE-CENTRE WAVE FUNCTIONS AND POTENTIALS. Faisal, F. H. M. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., B (London); 3: 636-40(May 1970).

The method of Harris and Michels (1965) is used to evaluate the single-center wave functions of a diatomic molecule using a two-centered LCAO–MO–SCF function. The static potential between the molecule and an incident electron is then calculated. The results for N_2 are given. (auth) (UK)

32645 ELECTRON–MOLECULE INTERACTIONS. II. SCATTERING BY CLOSED-SHELL DIATOMIC MOLECULES. Burke, P. G.; Sinfailam, A.-L. (Queen's Univ., Belfast). J. Phys., B (London); 3: 641-59(May 1970).

The theory of electron scattering by closed-shell diatomic molecules, assuming that the molecule is constrained to be in its ground electronic state, is developed. To simplify the analysis it is assumed that the molecule does not vibrate or rotate during the collision, and it is then shown how rotational excitation cross sections may be obtained from the asymptotic form of the scattered electron wave function. A general computer code based on this formalism and using single-center wave functions was written and is used to study $e^- - N_2$ collisions at low energies. A low-energy $^2\Pi_g$ resonance is found in agreement with recent experiments. (auth) (UK)

32646 A STUDY OF CHARGE-CHANGING COLLISIONS INVOLVING Mg^+, Fe^+, and Cu^+ IN THE ENERGY RANGE 5 TO 30 keV. Cobic, B.; Vujovic, M.; Matic, M. (Boris Kidrich Inst. of Nuclear Sciences, Belgrade). J. Phys., B (London); 3: 660-6(May 1970).

An investigation of one- and two-electron capture and one-electron loss processes was carried out for Mg^+, Fe^+, and Cu^+ on gases Ne, Kr, and N_2 in the energy range of 5 to 30 keV. The measurements were made under single-collision conditions using the beam technique. The characteristic behavior of σ_{12} cross section, for the investigated metal ions, in the velocity region $v < 10^8$ cm sec^{-1} is discussed. The theoretically calculated cross sections for the one-electron capture process are compared with those obtained experimentally. The two-electron capture process, leading to the formation of negative ions, was investigated for the case of Fe^+ on Kr. The analysis of the experimental results revealed the important role of two-step processes on the formation of Fe^- in the gas target thickness range of 10^{-3} to 10^{-2} torr cm. The experimentally obtained σ_{11} cross-section values for that case are compared with the theoretically calculated values. (auth) (UK)

32647 MULTIPLE IONIZATION OF Ar AND Mg BY ELECTRON IMPACT. Okudaira, Sadayuki; Kaneko, Yozaburo; Kanomata, Ichiro (Tokyo Metropolitan Univ.). J. Phys. Soc. Jap.; 28: 1536-41(Jun 1970).

Ionization efficiency curves (IE curves) of Ar and Mg are measured up to 1000 eV by a crossed-beam method. A mass spectrometer is used for separation of multiply charged ions. Abundance ratios of multiply charged ions to singly charged ions at 500 eV are obtained for Ar and Mg ions having charges of up to +5 and +3, respectively. The summations of the IE curves of multiply charged ions agree well with the absolute total ionization curves obtained by other workers. The IE curve of Ar^+ has two maxima at 45 and 90 eV. Remarkable structures are found at 255 eV for Ar^{3+} and Ar^{4+} and they are attributed to an Auger process or an electron shake-off caused by the ionization of inner-shell electrons. A break at 55 eV for Mg^{2+} is probably attributed to autoionization arising from the excitation of an inner-shell electron that occurs below 55 eV. The curves for Ar^{2+}, Mg^+, and Mg^{3+} seem to have no structures. (auth)

32648 ROTATIONAL EXCITATION OF THE HD MOLECULE BY LOW-ENERGY ELECTRON COLLISION. Takayanagi, Kazuo (Tokyo Univ.). J. Phys. Soc. Jap.; 28: 1527-35(Jun 1970).

The rotational excitation of HD by low-energy electron collision is discussed for the first time. In the thermal-energy region, the Born approximation is used to derive relevant cross sections semiquantitatively. In the eV region, the adiabatic approximation is used to discuss the problem qualitatively. It is found that except in the neighborhood of the threshold energy, the rotational excitation cross section $\sigma(J \rightarrow J + 2)$, J being the rotational quantum number of the molecule, does not change much when H_2 is replaced by HD. For HD, transitions with odd ΔJ are also allowed. However, the cross sections for these transitions are found to be fairly small. The momentum-transfer and the rotational stopping cross sections are discussed. Excitation of D_2 is also considered for comparison. (auth)

32649 CROSS SECTIONS FOR INNER-SHELL VACANCY PRODUCTION IN ION–ATOM COLLISIONS. Der, R. C.; Fortner, R. J.; Kavanagh, T. M.; Khan, J. M. (Univ. of California, Livermore). Phys. Rev. Lett.; 24: 1272-4(8 Jun 1970).

Cross sections for K-shell vacancy production in carbon atoms are measured for incident N^+, O^+, Ne^+, and Ar^+ in various energy ranges. The measured cross sections agree with a theoretical model based on the Landau–Zener theory of level crossing. (auth)

32650 MULTIPLE ELECTRON SCATTERING IN GASES. Haywood, C. A.; Dobson, G. (Univ. of Leicester, Eng.). J. Phys., B (London); 3: 603-18(May 1970).

A discrepancy between the form of the observed angular distribution functions for multiple scattering of medium-energy electrons in argon and that expected from the form of the single-collision function is investigated. The discrepancy is formulated in terms of a sequence bias, which is shown also to account for the differences between the observed and expected behavior of two other aspects of the shapes of the electron tracks. These aspects are the distribution of the sign of successive observed collisions in the projected track and the distribution of the area enclosed between the projected track and its chord. A sequence bias is then shown to be operating in the simulated tracks of electrons in a square lattice by an investigation of the same three aspects of the shapes of the tracks. It is therefore suggested that the discrepancies are due to a residual statistical geometrical order in the gas. (auth) (UK)

32651 IONIZATION AND DISSOCIATION OF MOLECULAR GASES BY 5- TO 45- keV HELIUM ATOMS. Browning, R.; Latimer, C. J.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 3: 667-75(May 1970).

The ionization produced by 5- to 45-keV helium atoms during passage through thin targets of H_2, N_2, O_2, CO, CO_2, and CH_4 was investigated by the mass-spectrometric analysis of the secondary ionic products of single collisions. The method ensured that all secondary product ions were collected and recorded with a high and uniform efficiency. Absolute cross sections for the production of particular fragment ions, derived from the measured relative abundances, were found to be considerably higher than some previously reported values. It is shown that the possible influence of fast metastable atoms on the measured cross sections is very small. In spite of the large energy defects associated with possible formation processes for different fragment ions, at the lowest impact energies dissociative ionization is shown to be the dominant ionizing mechanism for all the gases investigated. (auth) (UK)

32652 IONIZATION OF COMPLEX ATOMS BY ELECTRONS AND PROTONS. Kingston, A. E. (Queen's Univ., Belfast). J. Phys., B (London); 3: L45-8(May 1970).

Classical calculations suggest that there are small irregularities in the electron or proton ionization cross sections of complex atoms. These irregularities are due to the shape of the electron velocity distribution of the atomic electron. (auth) (UK)

32653 PLURAL ELECTRON SCATTERING AND THE INCLUSION OF PHASE FACTORS. Misell, D. L. (Queen Elizabeth Coll., London). J. Phys., A (London); 3: L9-10(May 1970).

A method is given for the calculation of the angular distributions of plurally scattered electrons for the case where the scattered wave is a complex quantity. An expression is given for the resultant scattered wave; the modulus of this quantity is then available for comparison with experiment. (auth) (UK)

32654 FIELD-THEORETIC TREATMENT OF IONIZATION OF H ATOM BY PROTONS. Chowdhury, A. Roy (Jadavpur Univ., Calcutta). Indian J. Phys.; 43: 415-18(Jul 1969).

An attempt is made to show the effect of statistics on the ionization cross section of hydrogen-like atoms by proton impact. An exchange term is obtained, whose evaluation is really difficult. Its effect is estimated to show a reduction in the value of the differential cross section. (auth)

32655 NONSPHERICAL SCATTERING AMPLITUDE FOR INELASTIC MOLECULAR COLLISIONS. Koehler, W. E.; Hess, S.; Waldmann, L. (Univ., Erlangen, Ger.). Z. Naturforsch.; 25a: 336-50(Mar 1970).

The rotational angular momentum dependence of the nonspherical scattering amplitude is investigated for inelastic collisions of linear molecules. As far as the approximation of small nonsphericity can be applied, this dependence is obtained from the angular momentum dependence of the nonspherical interaction potential. The connection between the nonspherical scattering amplitude and observables that can be measured by molecular scattering experiments involving a polarized beam is discussed. Some qualitative remarks are made on collision brackets occurring in the theoretical expressions for the bulk viscosity and for the Senftleben–Beenakker effect for H_2 and HD. (auth)

32656 COLLISION STRENGTHS FROM REACTANCE MATRICES. Saraph, H. E. (University Coll., London). Comput. Phys. Commun.; 1: 232-40(Apr 1970).

A standard format for the storage of reactance matrices for atomic scattering calculations is proposed. The program SIMMEG consists essentially of two parts: Part 1 reads the necessary data describing the scattering system, reserves storage locations for the expected R matrix elements, and then reads and sorts these elements; Part 2 calculates the collision strengths from which total collision cross sections can be obtained. Although the program is suitable for any scattering problem in L–S coupling, it is described here with reference to electron scattering by ions. The program is written in FORTRAN IV for IBM 360/65. (A.G.W.)

32657 EXCITATION AND IONIZATION PROCESSES IN ARGON COLLISIONS. Haugsjaa, Paul Osborne. Denver; Univ. of Denver (1969). 95p.

Thesis.

Measurements were made of the total ionization cross section for ground-state argon–argon collisions over an energy interval from 1.5 to 500 eV in excess of the ionization threshold in the center-of-mass system. The near threshold energy dependence suggested a cross section of the form $\sigma^- = 1.8 \times 10^{-21}$ cm^2 eV$^{-1.28}$ $(E_{excess})^{1.28}$. The cross section for fast forward-directed metastable argon atoms after $Ar^+ + Ar$ charge-transferring collisions was measured for low-energy collisions. It was found that two maxima in the cross section occurred, one at 14.6 eV and the other at 20.5 eV in the argon ion–atom center-of-mass system. The cross section at the first maximum was estimated to be about 10^{-3} Å^2. The states involved in this excitation were shown to be the two low-lying metastable states of argon at 11.55 and 11.72 eV. Metastable formation during collisions between ground state argon atoms was observed between threshold and 14.5 eV in the center-of-mass system. The cross section for this process was found to be, at the very most, 6×10^{-20} cm^2 for the energies studied. In both cases of metastable argon formation, detection was made by observation of the Penning ionization that occurred in an acetylene target when traversed by argon metastable atoms. The cross section for excitation to states of argon that decay by vuv photon emission was estimated by observation of the photon flux during argon–argon collisions. The occurrence of a small undulation in the cross section for photon production was observed to occur at exactly the same energy as a similar structure in the case of the ionization cross section measurement. (Diss. Abstr. Int., B)

32658 ELECTRON IMPACT ELASTIC AND IONIZATION CROSS SECTIONS FOR ATOMIC NITROGEN. O'Donnell, Robert Michael. Fort Worth, Tex.; Texas Christian Univ. (1969). 125p.

Thesis.

Electron-impact elastic and differential elastic cross sections were calculated for atomic nitrogen for an incident electron energy of 2.0 Rydbergs. Also computed was the differential ionization cross section for ejection of a 2p electron having a kinetic energy of 0.43 Rydbergs. Although no experimental results were found for direct comparison, reasonable agreement was obtained when the theoretical results were qualitatively compared with available data. The wave function of the atom–electron system was approximated by the superposition of two states, these being the initial target state of the overall system and the final continuum state. The continuum state was treated by restricting the integration over momentum space to a narrow band of momentum for the ejected electron. This restriction caused the elastic and inelastic differential equations to uncouple and allowed them to be solved separately instead of simultaneously as is usually the case in bound-state calculations. Both the elastic and inelastic wave functions were determined numerically by means of a partial wave analysis. The effects of exchange were accounted for by expressing all wave functions in the form of a Slater determinant. It was found that for an incident energy of 2 Rydbergs, the inclusion of exchange is very important since the calculated differential elastic scattering cross section was considerably different when exchange was neglected. Based on qualitative comparisons with available experimental results the method used in the investigation to calculate elastic and ionization cross sections appears capable of being extended to other complex atoms. (Diss. Abstr. Int., B)

32659 ENERGY DEPENDENCE OF THE 4610- AND 4765-A LINES OF Ar^+ EXCITED IN LOW-ENERGY $He^+ + Ar$ COLLISIONS. Lipeles, Martin (North American Rockwell Corp., Thousand Oaks, Calif.); Swift, Roderick D.; Longmire, Martin S.; Weinreb, Michael P. Phys. Rev. Lett.; 24: 799-801(13 Apr 1970).

The energy dependence of the 4610- and 4765-Å lines of Ar^+ excited in low-energy $He^+ + Ar$ collisions from threshold to 700-eV He^+ energy was measured. The 4610-Å line rises sharply with energy to a peak near threshold, while the rise of the 4765-Å line is more gradual than previously reported and than most other lines excited in this process. The 4765-Å line still shows, however, a much lower energy peak than predicted by the adiabatic hypothesis. The threshold behavior of the 4610- and 4765-

Å lines appears to be typical of lines emitted from levels with ^1D and ^3P parent terms, respectively. (auth)

32660 QUANTUM MECHANICS OF THE H + H_2 REACTION: EXACT SCATTERING PROBABILITIES FOR COLLINEAR COLLISIONS. Truhlar, Donald G.; Kuppermann, Aron (California Inst. of Tech., Pasadena). J. Chem. Phys.; 52: 3841-3(1 Apr 1970).

Results of exact quantum mechanical calculations of scattering probabilities for the H + H_2 reaction are presented. The calculations are based on assumptions that the atoms lie on a nonrotating line throughout the collision and that the system is electronically adiabatic. Calculations based on assumptions of vibrational adiabaticity and conservation of vibrational energy are also compared. (A.G.W.)

32661 THEORY OF PENNING IONIZATION. I. ATOMS. Miller, William H. (Univ. of California, Berkeley). J. Chem. Phys.; 52: 3563-72(1 Apr 1970).

The theory of Penning ionization (PI) and related associative ionization (AI) is developed and examined in a classical, semiclassical, and quantum mechanical framework, the correspondence between the several descriptions being explicitly deduced; formulas for total cross sections for PI and AI, angular distributions for PI, and the distribution of energies of the ionized electron are presented. The possibility of anomalous structure is seen to appear in the energy distribution of the ejected electrons if the difference between the A^*-B and $A-B^+$ potential curves has a local extremum as a function of internuclear distance. Classically, this appears as an infinity in the distribution of electron energies, but the quantum mechanical expressions are reduced to obtain a uniformly valid approximation; the transition region through the classical infinity is characterized by an Airy function. (auth)

32662 THEORETICAL INTERPRETATION OF THE ELECTRON SCATTERING SPECTRUM OF CO_2. Claydon, Charles R.; Segal, Gerald A.; Taylor, Howard S. (Univ. of Southern California, Los Angeles). J. Chem. Phys.; 52: 3387-98(1 Apr 1970).

A theoretical study of processes observed in electron–CO_2 scattering experiments is presented. Potential curves for CO_2^- are calculated to determine which scattering processes proceed through formation of short-lived negative molecule–ion compound states. The four dissociative attachment processes occurring below 20-eV incident energy are shown to result from four different electronic states of CO_2^-. Vibrational excitation of CO_2 in the 3.0- to 4.5-eV incident energy range is shown to proceed through compound-state formation. The calculated energies of the compound states are shown to agree with the absorption spectra of CO_2^- trapped in crystalline solids. The inelastic scattering below 3.0 eV is shown to be nonresonant and of a direct nature. For this process the leading term in the angular dependence of the cross section is determined by dipole selection rules, which leads to strong forward peaking. For small-angle scattering the cross section is shown to be about 10^{-16} to 10^{-17} cm^2 in magnitude. Further, the discussion on direct vibrational excitation cross sections will generally be valid for other nonpolar molecules with infrared-active vibrational modes. (auth)

32663 PARTICLE–ATOM INTERACTION POTENTIAL FOR LOW-ENERGY SCATTERING. Malinowski, S. (Univ. of Lodz, Poland). Acta Phys. Pol.; A37: 397-403(Mar 1970).

A method is presented that permits the particle–atom interaction potential to be found for arbitrary particle-to-atom distance. For $r' \to \infty$ the method gives the well-known expression for the interaction potential. The correction term $(2/\mu)\beta_d((Z')^2/r'^6)$ resulting from this method is just the zeroth-order adiabatic correction resulting from the relative motion: atom–scattered-particle. It thus seems reasonable to call this correction a zeroth-order correction for the atom–scattered-particle motion or a velocity-dependent dynamical correction, whereas it should not be called a nonadiabatic correction. (auth)

32664 MEASUREMENT OF THE TOTAL CROSS SECTION FOR ELASTIC SCATTERING OF LOW-ENERGY ELECTRONS BY ATOMIC HYDROGEN. Eisner, Philip Nathan. New York; New York Univ. (1969). 205p.

Thesis.

Measurements are presented of the total cross section for elastic scattering of low-energy electrons by atomic hydrogen using the recoil atomic-beam technique. Absolute cross sections, without normalization, were measured from 0.7 to 10.5 eV with an electron angular resolution of better than 6°. The results, accurate to ±25%, agree with variational calculations and with the normalized measured results of Neynaber et al. An atomic beam was formed by dissociation of H_2 in a cooled microwave discharge, and at right angles to the beam, an electron beam collided with the atoms. Observations were made on the hydrogen beam that remained after atoms were scattered out of it. A mass spectrometer was the detector. A multichannel analyzer recorded the atomic beam signal after the detection process. The analyzer switched the scattering electron beam on and off once every five seconds; the difference between the atomic beam signal with and without the electron beam is the scattering signal. Signals were accumulated for about two hours at each energy, then processed on a digital computer. The results of several such two-hour-long experiments were averaged together to arrive at the final cross section. The error in H-atom velocity measurement, the statistical errors in the hydrogen–electron cross section measurement due to the poor signal-to-noise ratio, and the imperfect knowledge of the hydrogen-atom-velocity distribution all combine to produce the uncertainty in the measurements of about ±25%. (Disser. Abstr. Int., B)

32665 TRANSITION RADIATION FROM AN IRRADIATED MULTILAYER. Shieh, S. Y. (Univ. of Tennessee, Knoxville). Phys. Rev., B; 1: 3338-40(15 Apr 1970).

A general formula for the transition radiation emitted by a uniformly moving charged particle normally incident on a multilayer, either self-supporting or deposited on a thick substrate, is calculated. This formula enables one to take into account for exact multilayer configuration of targets, e.g., oxide layers in the analysis of transition radiation data. (auth)

32666 REPORT ON ELASTIC COLLISIONS OF LOW-ENERGY ELECTRONS WITH ALKALI METALS. II. Bederson, Benjamin. (New York Univ., N. Y.). Comments At. Mol. Phys.; 2: 7-9(Apr-May 1970).

The current status of experimental work on elastic scattering of low-energy electrons by alkali metal vapors is summarized. The Ramsauer-type transmission measurements of R. B. Brode (Phys. Rev., 34: 673 (1929)) are discussed briefly and compared with more recent measurements classified into three groups: (1) spin-exchange work using optical pumping, (2) dc and microwave transport measurements in plasmas, and (3) crossed-beam measurements using the recoil technique. It is concluded that most of the discrepancies would be resolved if Brode's results were revised downward by about a factor of two. (A.G.W.)

32667 ELECTRON–ATOM COLLISIONS. II. EXCITATION. Burke, P. G. (Queen's Univ., Belfast). Comments At. Mol. Phys.; 2: 1-6(Apr-May 1970).

The theory of inelastic scattering of electrons by atoms and ions is reviewed. Various approximations used and the errors associated with these approximations are discussed. The optical potential, in particular, is considered. It is concluded that the final method of satisfactorily treating the infinity of channels that arise in electron–atom collisions must still await further work. (A.G.W.)

32668 EXPERIMENTAL STUDY OF LOW-ENERGY ELECTRON SCATTERING BY HELIUM ATOMS. Peresse, Joseph; Le Nadan, Andre; Gelebart, Francois (Brest Univ., France). Compt. Rend., Ser. B; 270: 1033-5(20 Apr 1970). (In French).

The resonance peak at 19.30 eV in elastic scattering is presented, and an inelastic scattering spectrum for incident electrons of 30 eV is given. (auth) (France)

32669 THEORY OF INELASTIC COLLISIONS. II. THE PROOF OF CONJECTURED RULES FOR THE WKB-TYPE GENERAL SOLUTIONS. Eu, Byung Chan (McGill Univ., Montreal). J. Chem. Phys.; 52: 3903-11(15 Apr 1970).

A set of the rules conjectured in the first paper of this series for obtaining the WKB-type general solutions of N-coupled radial Schroedinger equations is either derived or proved under an assumption of distinct eigenvalues of a matrix A_N^1 directly related to the coupled equations. These coupled radial Schroedinger equations occur in the multichannel approach in the theory of inelastic collisions of atoms and molecules. (auth)

32670 NONITERATIVE SOLUTIONS OF INTEGRAL EQUATIONS FOR SCATTERING. III. COUPLED OPEN AND CLOSED CHANNELS AND EIGENVALUE PROBLEMS. Sams, W. Neal; Kouri, Donald J. (Univ. of Houston, Tex.). J. Chem. Phys.; 52: 4144-50(15 Apr 1970).

The homogeneous integral solution formalism developed by Sams and Kouri is applied to the problems of coupled open- and closed-channel radial equations and coupled radial eigenvalue equations. The problem of coupled eigenvalue equations is considered first. Because the integral equation form of the Schroedinger equation is used, the proper solutions may be obtained by integrating from the origin outward, rather than both outward from and inward toward the origin. For the case of eigenvalue radial equations, quantization arises from the fact that exponentially de-

caying solutions are obtained only when the eigenvalue of a certain matrix equals one. Next, the coupled open- and closed-channel radial equations are considered. Unlike the case of coupled open channels, it is convenient to consider a column vector solution rather than a matrix. Just as in the open-channel case, however, the Volterra integral equations generated in solving the coupled open- and closed-channel equations are the same for the homogeneous and inhomogeneous integral solutions. Thus, the number of equations that must be solved is not as large as first appears. The method necessitates at most two matrix inversions, one for a n_0 by n_0 matrix and one for a n_c by n_c matrix, at the very end of the calculation. Here n_0 is the number of open channels and n_c the number of closed channels. Finally, application of the eigenvalue procedure is made to a Lennard–Jones (12–6) potential in order to illustrate the method. (auth)

32671 CHARGE EXCHANGE FOR H^+ AND H_2^+ IN H_2O, CO_2, AND NH_3. Coplan, M. A.; Ogilvie, K. W. (Univ. of Maryland, College Park). J. Chem. Phys.; 52: 4154-60(15 Apr 1970).

Differential charge-exchange cross sections were measured for H_2^+ and H^+ incident on H_2O, CO_2, and NH_3 in the incident ion energy range 30 to 500 eV. From retarding-potential and magnetic-deflection measurements the energy of the product ions was determined to be near thermal for all the systems. This is consistent with the narrow angular distribution of product ions and the observed asymmetry of the differential cross sections in the laboratory frame. Total cross sections were calculated from the differential results and compared with earlier measurements. Mechanisms for charge exchange for these systems are discussed in terms of the results. (auth)

32672 ALGEBRAIC CLOSE COUPLING CALCULATION OF ELECTRON–HYDROGEN SCATTERING. Callaway, J.; Oberoi, R. S.; Seiler, G. J. (Louisiana State Univ., Baton Rouge). Phys. Lett.; 31A: 547-9(18 May 1970).

A variational procedure described by Nesbet (Phys. Rev., 175: 134(1968)) was applied to a calculation of s-wave phase shifts in electron–hydrogen scattering, using the 1s–2s–2p close-coupling approach, for energies below the first excitation threshold. (auth)

Atomic Theory

32673 MOMENTA DISTRIBUTION IN ATOMS AND MOLECULES. CASE OF GAUSSIAN-TYPE WAVE FUNCTIONS. Tsapline, Bernard (Battelle Inst., Geneva); Roux, Monique; Cornille, Marguerite. Compt. Rend., Ser. B; 270: 865-8 (6 Apr 1970). (In French).

The distribution of the momenta of an atom was expressed in a single analytic formula, the wave function of the atom in the configuration space being developed on a gaussian-function basis. Applications are given for lithium. (France)

32674 SINGLE-PARTICLE SUBSTITUTION SUMS IN THE SECOND-ORDER Z-EXPANSION THEORY OF ATOMIC ENERGIES. Lewis, M. N. (Harvard Coll. Observatory, Cambridge, Mass.). Comput. Phys. Commun.; 1: 265-76(Apr 1970).

Program SPSS computes the single-particle substitution sums E_2' in the second-order term in the Z-expansion theory of the energies of many-electron atoms. E_2' is calculated as one, or the sum of several, generalized sums S_n', which may be given in the form of squares or product pairs of brackets containing one or several R^k integrals over an energy denominator. Any combination of R^k integrals (multiplied by coefficients) may be used, subject to the limits set by the dimension statements. The program is written in FORTRAN for CDC 6400. (A.G.W.)

32675 INTEGRAL-TRANSFORM GAUSSIAN FUNCTIONS FOR HELIUMLIKE SYSTEMS. Bishop, David M. (Univ. of Ottawa); Somorjai, R. L. J. Math. Phys. (N. Y.); 11: 1150-4 (Apr 1970).

The one-dimensional Laplace transform of the Gaussian exp $(-r^2x)$, $g(r) = \mathfrak{L}\{G(x)\} = \int_0^\infty e^{-r^2x} G(x)dx$, was used to generate functions that could be useful as basis sets for atomic and molecular calculations. A particular choice of the weighting function G(x) led to functions of the form $g(r) = (qr)^\nu K_\nu(qr)$, where $K_\nu(qr)$ are modified Bessel functions of the second kind. These functions were used as basis functions for the helium isoelectronic series and accounted for 98.98% (H^-), 99.89% (He), 99.96% (Li^+), 99.98% (Be^{++}), and 99.996% (O^{6+}) of the Hartree–Fock energy. (auth)

32676 QUASIPARTICLE FORMALISM AND ATOMIC SHELL THEORY. II. MIXED CONFIGURATIONS. Cunningham, M. J.; Wybourne, B. G. (Univ. of Canterbury, Christchurch, N. Z.). J. Math. Phys. (N. Y.); 11: 1288-95(Apr 1970).

The quasi-particle technique and formalism of an earlier paper is extended to describe general mixed configurations. The main features of the equivalent electron case are preserved, viz., a loss of spin quantum number and particle number, compensated by a rich classificatory scheme, and general operator-matrix-element evaluation without the use of coefficients of fractional parentage. (auth)

32677 RELAXATION TO QUANTUM STATISTICAL EQUILIBRIUM OF THE WIGNER–WEISSKOPF ATOM IN A ONE-DIMENSIONAL RADIATION FIELD. II. FINITE SYSTEMS. Davidson, Russell (Univ. of Texas, Austin); Kozak, John J. J. Math. Phys. (N. Y.); 11: 1420-36(Apr 1970).

A model is studied in which it was possible to obtain an expression for the exact solution of the master equation for the problem of spontaneous emission in a finite system. The model chosen for discussion is that of the Wigner–Weisskopf atom in interaction with a massless boson field, here 1-dimensional. The solution takes the form of a constant term plus a time-dependent one, expressed as the sum of residues at a series of poles along the real axis of a Laplace transform variable. Numerical calculations were performed on various aspects of the solution, and although these were too delicate to be quite certain around sensitive values of the time, the general picture is clear: After an initial decay to a value near zero, the series gave rise at fairly regular intervals to rapid and large fluctuations, the size of which never quite attains the initial value, but may nonetheless be large even after very long times. This result seems to be in agreement with the observation made by Zwanzig, namely, that for finite systems the master equation might demonstrate properties associated with the finite size of the system that would become important over certain long-time scales and would be ignored by the use of the customary "thermodynamic limit" of statistical mechanics. The relationship between this work and that of Montroll and Mazur and of Rubin is also discussed. (auth)

32678 MANY-ELECTRON THEORY: RELATIVISTIC AND NONRELATIVISTIC STUDIES. Shibuya, Tai-ichi. New Haven; Yale Univ. (1969). 254p.

Thesis.

This thesis consists of four different pieces of work, each of which forms one chapter, thus making four chapters as a whole. In Chapter I, a perturbation theory is developed for the spin-symmetry adapted spatial wave functions of many-electron systems. This is done on the basis of symmetric permutation group theory. Part I of this chapter deals with closed-shell systems. Group theoretical arguments are also discussed in Part I. Open-shell systems are studied in Part II. Chapter II presents a density matrix formulation of correlated many-fermion systems. These are all for the nonrelativistic theory. Chapter III, the largest part in volume, presents a critical survey on the studies of relativistic effects in atoms and molecules. Finally in Chapter IV an approach for relativistic correlation problems is presented. (Diss. Abstr. Int., B)

32679 ON THE RELAXATION TO QUANTUM-STATISTICAL EQUILIBRIUM OF THE WIGNER–WEISSKOPF ATOM IN A ONE-DIMENSIONAL RADIATION FIELD. I. A STUDY OF SPONTANEOUS EMISSION. Davidson, Russell (Univ. of Texas, Austin); Kozak, John J. J. Math. Phys. (N. Y.); 11: 189-202(Jan 1970).

A theoretical study of the phenomenon of spontaneous emission was carried out, using as a model the Wigner–Weisskopf atom in a one-dimensional radiation field. The calculation is performed within the framework of the Prigogine theory of nonequilibrium statistical mechanics. When the model is solved exactly to first order in the coupling parameter α and the evolution in time of the diagonal elements of the density matrix ρ is studied, it is found that the relaxation to equilibrium is characterized in part by a sequence of slowly damped oscillations. This result seems to be in agreement with the observation made by Zwanzig, namely, that exponential decay in time seems not to be universal, and may, in fact, be hidden behind some other kind of time dependence. An approximate theory is developed alongside the exact one, and corresponding terms in each treatment are compared numerically. It is found that, for small values of the coupling parameter α ($\alpha \leq 0.1$) and for sufficiently large values of τ, defined as $\tau = \alpha Et$ where E is frequency and t is time, the approximate theory gives a satisfactory representation of the exact solution to first order in α. The importance and relevance of the model introduced by Van Hove and coworkers, in which nonexponential behavior was also observed, is noted but not stressed. Finally, the possible relevance of the theory to a problem of interest in magnetic resonance is mentioned. (auth)

32680 VARIATIONAL PERTURBATION THEORY STUDY OF SOME EXCITED STATES OF TWO-ELECTRON ATOMS. Aashamar, Kjell; Lyslo, Gudmund; Midtdal, John (Univ. of Oslo). J. Chem. Phys.; 52: 3324-36(1 Apr 1970).

The Hylleraas–Scherr–Knight variational perturbation method was applied to the two-electron states $1s3s\ ^{3,1}S$ and $1s3p\ ^{3,1}P$. The calculations were carried through to 20th-order wave functions, with 96-, 126-, and 162-term expansions of the Hylleraas type, thus yielding estimates of the energy through the 41st order. The perturbation energy coefficients are tabulated through the 21st order for the states $1s2s\ ^{3,1}S$, $1s2p\ ^{3,1}P$, $1s3s\ ^{3,1}S$, and $1s3p\ ^{3,1}P$, and the corresponding nonrelativistic energies are presented for the first 10 elements of the helium isoelectronic sequence, with the exception of H^- to which the perturbation expansions do not apply. Where comparison is possible, the results are in fair agreement with those obtained from conventional variational calculations. A survey of the variational perturbation procedure is also given, presenting the basic formulas and phrasing two important theorems. (auth)

32681 TWO-ELECTRON FRACTIONAL PARENTAGE COEFFICIENTS FOR THE CONFIGURATIONS l^n. Donlan, Vincent L. (Air Force Materials Lab., Wright-Patterson AFB, Ohio). J. Chem. Phys.; 52: 3431-8(1 Apr 1970).

An equation for computing the two-electron fractional parentage coefficients of the configurations l^n in terms of the one-electron fractional parentage coefficients of l^n and l^{n-1} is derived. Abbreviated tables of the two-electron coefficients of the lowest lying terms of the d^n and f^n configurations are given. The orthogonality, charge conjugation, and symmetry properties of the two-electron fractional parentage coefficients are discussed briefly. The use of the coefficients in calculating matrix elements of two-particle operators is discussed, and the appropriate equations are given. (auth)

32682 ALTERNATIVE TECHNIQUE FOR THE CALCULATION OF SINGLE-DETERMINANT OPEN-SHELL SCF FUNCTIONS WHICH ARE EIGENFUNCTIONS OF S^2. Segal, Gerald A. (Univ. of Southern California, Los Angeles). J. Chem. Phys.; 52: 3530-3(1 Apr 1970).

The most general possible restriction is developed such that a single-determinant open-shell SCF wave function shall be an eigenfunction of S^2. A method of satisfying this restriction by partitioning of the variational basis set is given. The method is computationally distinct from the equivalence restriction procedure of Roothaan, but yields results equivalent to it. A pilot calculation on the $^2\Sigma^+$ state of BO is carried out as an explicit example of the new method. (auth)

32683 SPIN–ORBIT COUPLING: A WEAK FORCE WITH CONSPICUOUS EFFECTS. Fano, Ugo (Univ. of Chicago). Comments At. Mol. Phys.; 2: 30-5(Apr-May 1970).

Aspects of spin–orbit coupling that appear helpful for the analysis and application of its effects are summarized. Observable effects in the theory of electron spin polarization by elastic scattering and in the theory of photoelectron spin polarization by absorption of circularly polarized light are formulated in terms of suitably reduced values of the quantum defect difference of doublet levels, $\Delta\mu$. Other effects mentioned include the disporportionate influence on atomic spectra and the role of heavy atoms in accelerating singlet–triplet transitions in organic molecules. (A.G.W.)

32684 ELECTRON ENERGY LEVELS AT Z > 137. Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl); 11: 162-5(5 Mar 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 254-6(5 Mar 1970).

The question of the maximum possible nuclear charge is discussed in relation to the well-known fact that the solution of the Dirac equation in the field of a point charge Ze is mathematically correct only if Z < 137. Calculations based on two models in which the charge (1) is on the surface of the nucleus and (2) is uniformly distributed over the volume of the nucleus, give values of 171 and 168, respectively. The question of what happens when Z is greater than the critical value is then considered, and the probability of spontaneous pair production is calculated. (A.G.W.)

32685 TESTS OF THE MULTICONFIGURATION ENERGY-BOUND METHOD FOR FESHBACH-TYPE AUTOIONIZATION STATES OF TWO-ELECTRON ATOMS. I. APPLICATION TO He STATES BELOW THE N equals 2 THRESHOLD. Holoeien, E.; Midtdal, J. (Univ. of Oslo). J. Phys., B (London); 3: 592-602 (May 1970).

It has been argued that the conventional multiconfiguration method does not provide bounds to the energies of certain atomic autoionization states. Recently, according to the Q-space definition of Feshbach-type autoionization states, a multiconfiguration energy-bound theorem (minimum principle) has been given by Perkins (1968, 1969) for such states of two-electron atoms. The multiconfiguration stabilization method of Holøien is consistent with the energy-bound theorem requirement and is thus an upper-bound procedure. To test the upper-bound property of this method, hereafter called the multiconfiguration energy-bound method, and its convergence in the limit from above to the Feshbach projection method, further extensive variational calculations were carried through. Results obtained for many of the lowest-lying states of the specific symmetry $^1S^e$ of helium below the n = 2 threshold are given in the present paper. (auth) (UK)

Cosmic Radiation

Refer also to abstracts 31758, 32951, and 32972.

32686 (AD-698748) EFFECTS OF SUDDEN COMMENCEMENTS ON SOLAR PROTONS AT THE SYNCHRONOUS ORBIT. Paulikas, George A.; Blake, J. Bernard (Aerospace Corp., El Segundo, Calif.). 25 Oct 1969. 31p. (TR-66(5260-20)-7; SAMSO-TR-69-387). CFSTI.

Increases in solar proton flux coincident with sudden commencements were observed by detectors aboard the geostationary ATS-1 satellite during 1967 and 1968. The flux increases are of short duration (<30 minutes) and are of magnetospheric origin. Decay of the proton flux after the sudden commencement enhancement is consistent with pitch-angle scattering by hydromagnetic waves. (auth) (USGRDR)

32687 ATTENUATION LENGTH OF EAS. Ueda, Akira (Kyoto Univ.). Uchusen Kenkyu; 14: 244-5(Oct 1969). (In Japanese).

In high-energy phenomenology, the attenuation length λ of EAS is an important parameter. It was found that the size dependence of λ determined from calculation is significantly different from experimental data. This has been discussed on occasions. Comparing the result of simulation with the experimental data obtained at Norikura, Sasaki found that the value of λ obtained by the simulation is smaller for the primary energy $E_0 = 10^6$ GeV than for $E_0 = 2.5 \times 10^5$ GeV. Some comments are given on this phenomena. It is shown that the events not yet in the decaying stage were included in higher ratio in the simulation for $E_0 = 2.5 \times 10^5$ GeV due to fluctuation, and this was responsible for the larger average of λ. The average λ decreased with the increase of shower size also in the City University's experiment, and this may be attributed to the same reason. The calculated λ is larger than the measured value. This is still unsolved. (NSA of Japan)

32688 NORIKURA EAS ARRAY AND ITS ACCESSORIES. Ito, Nobuo; Sakuyama, Hiroshi (Osaka City Univ.). Uchusen Kenkyu; 14: 253-72(Oct 1969). (In Japanese).

The results obtained with the Norikura EAS array by Osaka City Univ. group during the period from July 1968 to Jan. 1969 are reported. The attenuation length of EAS was measured with a water tank of 2 m in depth. The area of 3×4 m^2 above and below the tank was covered by 48 plastic scintillators each. The results are shown and compared with the calculated distribution. The core of EAS was measured also. About 25% of observed cores showed the complicated structure of "multiple core." The lateral structure of EAS was observed with 100 scintillators. Examples of lateral structure are given. The two-dimensional structure of a multiple core is shown. The lateral density distribution of μ mesons was also measured with a neon hodoscope. The size dependence of muon density at 30 m from the axis of EAS is approximately given by $Ne^{0.9}$. The energy spectrum of the nucleon component in EAS was measured. The longitudinal development of a shower was observed with a cloud chamber and scintillators. When the core axis crossed the chamber, γ families, mostly in pairs, were found. Photos are shown and the results are discussed. (NSA of Japan)

32689 RADIO EMISSION FROM AIR SHOWER. EXPERIMENTS HITHERTO PERFORMED. Fujii, Masami (Tokyo Univ.). Uchusen Kenkyu; 14: 338-45(Oct 1969). (In Japanese).

Several mechanisms have been proposed for the radio emission from air shower. Each mechanism has its proper polarization of radio pulse, therefore observation has been made to detect the polarization. Observations hitherto made are arranged by frequency. The frequency of observed radio emission ranged from 12 to 90 MHz. The east–west polarization, which characterizes the radio emission due to the geomagnetic deflection of charged particles, was observed for the frequency below 32 MHz. Above this frequency, no definite polarization of radio emission was observed. This is in agreement with theoretical expectation. The observations at Kharkov, Calgary, Haverah Park, Jodrell Bank, and Chacaltaya are briefly discussed, with special emphasis on the lateral distribution and the type of antenna used. A preliminary experiment was performed to investigate the nature of background pulses. The result is briefly reported. (NSA of Japan)

32690 MECHANISM FOR THE RADIO EMISSION FROM AIR SHOWER. Fujii, Masami; Nishimura, Jun (Tokyo Univ.). Uchusen Kenkyu; 14: 346-71(Oct 1969). (In Japanese).

The mechanisms for radio emission hitherto proposed are reviewed. Two mechanisms, the deflection of charged particles in the geomagnetic field, and Cherenkov radiation with excess negative charge, are examined in detail. The contribution of the Compton effect, which was neglected in the Kahn–Lerche theory, is taken into account. It is shown that the radio emission due to the geomagnetic deflection of charged particles is polarized in an east–west direction, and that the Cherenkov radiation is polarized in a radial direction. The process of radio emission is investigated by considering the three-dimensional distribution of charge. The interference effect due to the finite thickness of shower front and the space distribution of charge is quantitatively discussed for various cases. It is shown that the east–west polarization is greatly reduced due to the interference effect above 30 MHz. Comparisons of the calculations and the observations at Haverah Park show qualitative agreement. (NSA of Japan)

32691 ELEMENTARY COMPOSITION AND ORIGIN OF PRIMARY COSMIC RADIATION. Koch, Lydie (CEN, Saclay, France). Nucleus (Paris); 10: 324-38(1969). (In French).

The characteristics of cosmic radiation reaching the earth and which has been altered by the interplanetary medium, the geomagnetic field, and the terrestrial atmosphere, are summarized with respect to the intensity, nature, and energy. The abundance of hydrogen, helium, and the light elements (Li, Be, B) in celestial objects and in cosmic radiation is compared and the elements with average and heavy atomic numbers in cosmic radiation (nuclei from C to Fe) are discussed. The abundance of nuclei beyond Ni in cosmic radiation is estimated. The flux of cosmic particles on the earth is calculated as a function of their energy The anisotropy of cosmic radiation and long-term stability is considered. The astrophysical data that can be deduced from the study of cosmic radiation include: information on the galactic magnetic field, density of the interstellar medium, residence time of cosmic radiation in this medium, and possible sources of cosmic radiation. Experimental problems to be solved are illustrated with examples of experiments in operation and planned. (J.S.R.)

32692 COSMIC RAYS. Teisseyre, Roman (ed.). Materialy i Prace, No. 18. Warszawa; Panstwowe Wydawnictwo Naukowe (1967). 52p. (In Polish and English).

The experimental arrangement and pulse counting scheme for the cosmic-ray station of the Central Geophysical Observatory are discussed and illustrated. Two-hour intensity values of the meson component along with corrections for the barometric effect are given. Two-hour mean pressure values for the period Jan. 23 to Dec. 31, 1966 are also given. (W.D.M.)

32693 ALTITUDE DEPENDENCE OF THE QUIET-TIME COSMIC-RAY IONIZATION OVER THE POLAR REGIONS AT SOLAR MINIMUM. George, Michael J. (California Inst. of Tech., Pasadena). J. Geophys. Res.; 75: 3154-8(1 Jun 1970).

The integrating ionization chamber on the OGO 2 satellite measured the quiet-time cosmic-ray ionization from 430 to 1540 km over the polar regions. After correction for time variations and spacecraft radioactivity, ionization averages were fitted to analytical functions which describe the primary and splash-albedo components of the cosmic rays. Extrapolating to the top of the atmosphere and to infinity, the ionizations are 550 ± 10 and 985 ± 6 ion pairs/(cm^3 sec atm), respectively, and splash albedo contributes $10.4 \pm 2.3\%$ of the total ionization at the top of the atmosphere. These results apply to early November 1965 and are compared with balloon and interplanetary values obtained for similar intensity levels with similar instruments. An interesting side result is another estimate of the radial gradient of the ionization, $8.5 \pm 3.1\%$/AU. (auth)

32694 OBSERVATIONS OF THE COSMIC-RAY KNEE WITH A POLAR-ORBITING IONIZATION CHAMBER. George, Michael J. (California Inst. of Tech., Pasadena). J. Geophys. Res.; 75: 3159-66(1 Jun 1970).

The cosmic-ray knee was observed with the ion chambers on the OGO 2 (October 1965–February 1966) and OGO 4 (August 1967) polar-orbiting satellites, using the same graphical definition that applies to balloon observations. The knee is interpreted as a position in the geomagnetic field, which depends on the cosmic-ray rigidity spectrum at the time of observation, where the cosmic-ray cutoff rigidity has a particular value and is about 1.2 bV for the OGO 2 measurements. The invariant latitude of the knee decreases with altitude of observation at the rate of $(2.5 \pm 0.5) \times 10^{-3}$ degree/km and had the value 59.1° at the surface of the Earth in 1965–1966. This invariant latitude should be independent of longitude; in fact, however, a slight longitude dependence of the order of ±1° is observed. Knee latitudes were 0.6° lower (toward the equator) in 1967, according to OGO 4, and 4° to 5° lower in 1961 as measured by other observers. A north–south latitude difference of $0.6° \pm 0.4°$ is found, which suggests a seasonal variation with the knee slightly closer to the pole during winter. A small diurnal variation of the knee latitude with amplitude $0.5° \pm 0.4°$ is indicated; this appears to be consistent with calculations and observations for higher latitudes. (auth)

32695 STATISTICAL DISCRETE-SOURCE MODEL OF LOCAL COSMIC RAYS. Ramaty, R. (Goddard Space Flight Center, Greenbelt, Md.); Reames, D. V.; Lingenfelter, R. E. Phys. Rev. Lett.; 24: 913-16(20 Apr 1970).

The anisotropy, lifetime, and fluctuations of the cosmic rays are considered for a model in which the cosmic-ray sources are random discrete events in space–time. (auth)

32696 CALCULATED COSMIC-RAY IONIZATION IN THE ATMOSPHERE. O'Brien, Keran (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 13: 414-15(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32697 SPECTRUM OF COSMIC-RAY EXTENSIVE AIR SHOWER IN HIGH MOUNTAINS. Hlavac, Teodor (Inst. of Experimental Physics, Kosice, Czech.). Fyz. Cas.; 20: No. 1, 61-5(1970). (In Czech).

The spectrum of cosmic-ray extensive air showers was measured at the cosmic-ray station in the Tien-Shan (3340 meters) with large-array scintillators. For "small" showers ($n = 10^3$ to 10^4) the value $\gamma = 1.2$ was obtained, and $\gamma = 1.6$ for showers with $N > 10^4$. (JPRS)

32698 HISTORICAL REVIEW OF TECHNOLOGY OF AIR SHOWER OBSERVATION. Kino, Shigeru (Osaka City Univ.). Uchusen Kenkyu; 14: 241-3(Oct 1969). (In Japanese).

The historical development of the technology of air shower observation is briefly reviewed. The detectors used for the observations are G–M counters, ionization chambers, cloud chambers, neon flash tubes, Cherenkov detectors, BF_3 counters, proportional counters, scintillators, spark chambers, and emulsions. These detectors have been used in combination. (i) EAS array to determine the size and lateral structure of EAS. Plastic scintillators were used by many groups, and recently a large array of 500 m and 2 km was constructed at Haverah Park, for which a water Cherenkov detector was used. (ii) Observation of the nuclear interaction in EAS. Material absorbers such as Pb or Fe were used in combination with the detectors, such as calorimeters (Moscow group), total absorption spectrometers (Ootacamund), E.C.C. (Japan–Brazil), and multiplate cloud chambers (Norikura). (iii) Core observation. Construction of the apparatus for this purpose is very active, especially for the study of multiple cores. (iv) Incident-angle measurement. A combination of scintillators of high time resolution with quick-response electronics is used. New observational techniques, such as those for the radio and the optical observation are briefly described. (NSA of Japan)

Direct Energy Conversion

Refer also to abstract 31538.

32699 POTENTIAL DISTRIBUTION IN A TWO-EMITTER DIODE. Troppmann, Manfred (Institut fuer Plasmaphysik GmbH, Garching, Ger.). Z. Naturforsch.; 25a: 504-18(Apr 1970).

The existing model of a "collisionless" alkali plasma diode is extended, including the case of two incandescent plane electrodes emitting electrons as well as ions with a half-Maxwellian velocity distribution. The potential distributions within the diode space derived from this theory are examined in detail. Physically necessary conditions reduce the well-known ambiguity of solutions to a single one (with uniform plasma potential) at a given set of parameters. Further solutions, corresponding to spatially oscillatory potential shapes that are consistent with the collisionless theory, disappear if the ion–ion collision probability within the diode plasma exceeds 0.1 per emitter distance. In the experiment, the potential distributions are scanned using a new electron-beam probing technique. Results agree with the theory. (auth)

32700 ANODE CURRENT AND HEAT FLUX DISTRIBUTION IN AN MPD ENGINE. Shih, K. T. (General Dynamics, San Diego, Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 377-8(Feb 1970).

An axially segmented anode is used to measure the axial anode currents and heat flux distributions. These distributions provide information about where the important ionization, current, and

heat effects take place, and the extent of the high current density zone. They also serve as an independent check of the anode heat-transfer model. (M.H.R.)

32701 ELECTRODE ENERGY TRANSFER MECHANISMS IN AN MPD ARC. Shih, K. T. (General Dynamics/Convair, San Diego, Calif.); Pfender, E. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 211-15(Feb 1970).

A segmented anode is used for the confirmation of a proposed energy transfer model and for the measurements of circumferential current and heat flux distributions of a magnetoplasmadynamic arc. Two arc modes are observed; a mode with an asymmetric but steady-state current distribution and a mode with a rotating current spoke. The former occurs preferentially at higher gas injection velocities. There is no continuous transition between these two modes. By applying the experimental results to the anode energy transfer model, the contribution of the various energy transfer mechanisms to the observed anode energy fluxes can be determined. The energy flux due to the electron current is found to be the dominant mechanism. The net energy transfer to the cathode is much smaller than that to the anode, amounting to a few percent only in an over-all energy balance. (auth)

32702 THERMOELECTRIC POWER OF STABILIZED ZIRCONIA. Pizzini, S.; Riccardi, C.; Wagner, V.; Sinistri, C. (Univ., Pavia, Italy). Z. Naturforsch.; 25a: 559-65(Apr 1970).

The thermoelectric power of stabilized zirconia, at different CaO and MgO concentrations within the cubic phase, has been measured. The results show a concentration dependence of the thermoelectric power which is discussed. The homogeneous part of the thermoelectric power is discussed with the classical approach of irreversible thermodynamics. (auth)

32703 KINETICS OF RECOVERING SULFUR FROM THE SPENT SEED IN A MAGNETOHYDRODYNAMIC (MHD) POWER PLANT. Feldmann, H. F.; Simons, W. H.; Gallagher, J. J.; Bienstock, D. (Pittsburgh Coal Research Center). Environ. Sci. Technol.; 4: 496-502(Jun 1970).

Sulfur can be eliminated from the effluent gases of open-cycle MHD-topped power plants by recovering it from the recycling seed–slag mixture with hydrogen. The incorporation of this recovery step is a simple matter in the MHD-power station, because a potassium or cesium seeding material, which has a great affinity for sulfur, is added to make the combustion gas electrically conductive, and this seed must be recovered and recycled. The kinetic model for the stripping of sulfur as hydrogen sulfide from seed–slag mixtures can be used to design reactors for this purpose. The model also describes the regeneration of the absorbent in the alkalized alumina process for removing sulfur dioxide from power plant stack gases. (auth)

Fluid Physics

32704 (JUL-623-TP) EVALUATION OF THE DIFFUSION AND HEAT TRANSPORT COEFFICIENTS OF A NEAR-EQUILIBRIUM MULTITEMPERATURE GAS MIXTURE IN A STATIONARY ELECTROMAGNETIC FIELD FOR THE CASE OF A PARTIALLY IONIZED FOUR-COMPONENT PLASMA WITH HIGH-ELECTRON TEMPERATURE. Claassen, H. A. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Nov 1969. 49p. (In German). Dep. CFSTI (U. S. Sales Only).

The general formulas derived earlier for the diffusion and heat transport coefficients of near-equilibrium ionized N components of a multi-temperature gas mixture in the stationary electromagnetic field, and put in an explicit form for the case N = 4 by evaluation of the determinants occurring and systemization of the results, were applied to the case of a neutral gas with low partially ionized gas addition, i.e., to the case of a four-component plasma with a single ion type. The simplifications in the matrix elements (which determines the transport coefficients) resulting from the existence of an electron gas component and the assumption of a low partial pressure of the gas addition were made in relation to estimations on the mean collision frequencies or mean flight time of the colliding particle types. The necessary estimates on the order of magnitude of the diffusion transport cross sections for elastic two-particle interactions were obtained from an approximate investigation of the Chapman–Cowling integrals for the variously occurring spherical symmetric interaction potentials of the colliding particles. In the approximation selected for the matrix elements, relatively simple expressions can be found for the transport coefficients in the diffusion equations for electrons and ions, as well as in the heat transport equation for electrons and heavy particles. The simplified forms of the generalized laws of Ohm and Fourier are given from the simplified diffusion and heat transport equations. It was assumed that the electron temperature can be above the temperature of the heavy particles. (tr-auth)

32705 (JUL-624-TP) THE LAMINAR ELECTRODE BOUNDARY LAYER OF A LINEAR MAGNETOGASDYNAMIC CHANNEL FLOW OF PARTIALLY IONIZED FOUR-COMPONENT PLASMA WITH HIGH-ELECTRON TEMPERATURE. Claassen, H. A. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Nov 1969. 78p. (In German). Dep. CFSTI (U. S. Sales Only).

The problem of a magnetogasdynamic boundary layer is treated under the special aspect of a partially ionized anisotropic plasma with high electron temperature, which was fed from a hot electrode with the electrons necessary for current transport. The special forms of the boundary-layer equations are derived by use of the transport equations given previously and are provided with a supplementary boundary condition for the electron temperature resulting from the theory of the collision-free Langmuir layer in the case $|\omega_\alpha \tau_\alpha| \lambda_d / \lambda_{\alpha f} \ll 1$ (λ_d = Debye length, $|\omega_\alpha \tau_\alpha|$, $\lambda_{\alpha f}$ = Hall parameter, mean free path length of the plasma component α). The boundary-layer equations are transformed with respect to the possibility of local similar solutions. The transformation used limits the large number of possible nuclear currents to the special case of an isothermal electromagnetic accelerated plasma flow. The results of a numerical solution of the transformed boundary-layer equations are discussed and the limits of the theory are indicated. (tr-auth)

32706 STABILITY OF A GRAVITATING FLUID LAYER OF INFINITE EXTENT BUT FINITE THICKNESS WITH A FORCE-FREE MAGNETIC FIELD. Das, K. P. (Jalpaiguri Government Engineering Coll., West Bengal, India). Indian J. Phys.; 43: 391-8(Jul 1969).

The stability of a gravitating, homogeneous, incompressible and infinitely conducting fluid layer of infinite extent but finite thickness is investigated in the presence of a force-free magnetic field. The critical wave numbers for the onset of instability are calculated for some assigned strengths of magnetic field. It is found that stability increases with the increase of mean magnetic field. The wavelength for maximum instability and corresponding maximum growth rate of instability are calculated. (auth)

32707 MAGNETOHYDRODYNAMIC FLOW PAST A YAWED SEMI-INFINITE FLAT PLATE IN THE PRESENCE OF A PRESSURE GRADIENT. Rimmer, Peter L. (Univ. of Manchester, Eng.). Z. Angew. Math. Phys.; 21: 211-23(25 Mar 1970).

The analysis of problems of a two-dimensional flow past a two-dimensional body has been extended previously to certain pseudo-three-dimensional flows, in which the original two-dimensional motion is unaffected, by allowing either the incident stream or the body to possess a constant component of velocity perpendicular to the two-dimensional motion. This approach is applied here to MHD problems. An example is given of this by studying the boundary of an electrically conducting viscous fluid past a yawed semi-infinite flat plate $y = 0$, $x \geq 0$ in the presence of an MHD pressure gradient proportional to a power of x. The method used is that of matched asymptotic expansions valid for the cases of large and of small values of the ratio of the viscous to the magnetic diffusivity The first two terms of the expansion for the skin friction in the z direction are obtained and numerical results are given for the values of the pressure-gradient parameter corresponding to the cases of a yawed semi-infinite flat plate and a yawed circular cylinder in a uniform stream. (M.H.R.)

32708 MHD WAVES IN THE INNER MAGNETOSHEATH. Horng, Jiann Tsorng. Durham, N. H.; Univ. of New Hampshire (1969). 80p.

Thesis.

Properties of MHD discontinuities are discussed with emphasis on the magnetic field. Numerical solutions for large amplitude fast and slow simple waves are obtained and plotted in the $\rho' - B_t'$ plane, where ρ' is proportional to the particle density and B_t' is proportional to the transverse magnetic field strength. Models are also proposed to illustrate the magnetic field configuration in the transition region within 1 earth radius of the magnetopause. The wave propagation vector $\vec{k}$ is calculated by assuming it lies in the direction which minimizes the variance of $\mathbf{B} \cdot \hat{n}$, where n is a variable unit vector. Magnetic fields observed by Explorer 12 are then projected onto a coordinate system in which $\vec{k}$ is one axis. Wave polarizations are studied in this projection. Fluctuations of the density and total pressure (magnetic plus particle pressure) of the fluid are in phase with fluctuations of the tangential magnetic field for the fast simple magnetosonic wave. Fluctuations of the fluid density are 180° out of phase with fluctuations of the tangential magnetic field for the slow simple magnetosonic wave. Fast and slow waves are associated with changes in only the magnitude of

the tangential magnetic field. Transverse waves are associated with only a rotation of the tangential field. The total pressure can remain nearly constant across a slow wave but not across a fast wave. As a result, slow waves in the inner magnetosheath need not produce large variations in the total pressure on the magnetopause, while fast wave must produce large variations in the total pressure on the magnetopause. The periods or quasi-periods of the HM waves observed in the magnetosheath are found to range from 10 seconds to 90 seconds, and the amplitudes range from 10 to 30 gammas. The lower limits on periods and amplitudes are a result of data limitations. A physical picture of the magnetic field fluctuations in the inner magnetosheath is obtained from the data when presented in geomagnetic coordinates. Physically a slow magnetoacoustic wave whose propagation vector is perpendicular to $\vec{B}$ is similar to a frozen-in cloud of plasma. The magnetic field direction is observed to change more in the low field regions than in the high field regions. An increase in the flux of low energy electrons is also usually observed in the low field regions. This indicates that the weak field regions are associated with high plasma densities. Taken together, these observations suggest that elongated plasma clouds occupy the low field regions. The large magnetic field fluctuations observed in the inner magnetosheath are produced as these plasma clouds move past the satellite. (Diss. Abstr. Int., B)

32709 NONSIMILAR MHD BOUNDARY LAYERS ON INSULATING WALLS. Hunter, Louis George Jr. Knoxville, Tenn.; Univ. of Tennessee (1969). 180p.

Thesis.

A numerical analysis of the flow field (inviscid core and boundary layer) is presented which is typical of those found in a combustion-driven supersonic MHD generator. The geometrical configuration analyzed was a semi-infinite plane channel with crossed electric and magnetic fields. The boundary layer gasdynamic and electromagnetic properties were studied under the following conditions: (1) wall temperature variation, (2) large applied magnetic field, (3) Hall effect included or excluded, and (4) stagnation pressure variation. In a large B field, separation occurs at a relatively short distance from the channel entrance. Separation occurs farther upstream where the Hall effect is included, the wall temperature increased and where the loading factor and stagnation pressure are decreased. For the hot-wall case, shorting is severe and joule heating is under-predicted when the Hall effect is neglected. However, when the Hall effect is included and the Hall parameter is one or greater, shorting does not exist in the hot-wall boundary layer. A modified Levy–Lees transformation was developed, which permitted the boundary layer phenomena to be scaled in the physical plane by the magnitude of the applied magnetic field where the Hall effect was neglected. The non-similar boundary layer analysis was accomplished by an implicit finite difference formulation and properties were treated as variables. (Diss. Abstr. Int., B)

32710 HYPERLIPTIC MAGNETOHYDRODYNAMIC STEADY FLOW PAST A POINT SOURCE. Friedlander, Stanley. New York; New York Univ. (1969). 94p.

Thesis.

The disturbance field generated by a point source is obtained for steady, three-dimensional, isentropic, magnetohydrodynamic flow. The flow is governed by the Lundquist equations linearized about constant velocity, matter density, and magnetic field. The flow is assumed to be hyperliptic, i.e., the negative of the free-stream velocity lies within the fast wave front of the time-dependent characteristic surface but outside the two cusped slow wave fronts of this surface. There are both real and complex characteristics. New dependent variables are introduced that separate the flow into transverse and compressive components. The transverse component is propagated one-dimensionally with the Alfven velocity. The determination of the compressive component is reduced to finding the fundamental solution of a fourth-order homogeneous differential equation with constant coefficients. The solution is required to satisfy smoothness and causality conditions and a condition on the growth at infinity. The fundamental solution is found by extending the plane wave representation for the fundamental solution of hyperbolic equations to the hyperliptic case. The fundamental solution for a hyperbolic equation is extended to include plane waves with complex wave speeds. This function will not be continuous across the plane $z = 0$. A solution for $z \neq 0$ of the homogeneous equation is then added so that the resulting function is smooth across $z = 0$, $x^2 + y^2 \neq 0$. This function is shown to be the fundamental solution for the compressive component of the steady flow. Since there are two directions for which the real wave speeds coincide, it is possible that the solution is singular across the part of the plane ruled by the tangent half lines to the line segment joining the slow wave fronts of the time-dependent characteristic surface. The steady flow is shown to be smooth across this surface. The singularities of the steady flow across the forward-facing nappes of the characteristic cone are computed. (Diss. Abstr. Int., B)

32711 HYPERBOLIC ALIGNED MAGNETOGASDYNAMIC FLOW OVER A CONE. Bertram, Lee Alfred. Chicago; Illinois Inst. of Tech. (1969). 148p.

Thesis.

Steady, dissipationless, aligned field flow of a perfect gas over axisymmetric nonconducting bodies is examined for flow conditions such that the Alfvén number, $A = q/b$ = (flow speed/Alfvén wave speed), and Mach number $M = q/a$ = (flow speed/acoustic speed), are in the regions ($A \geq 1$, $M \geq 1$) or ($A^2 + M^2 \geq 1$, $A \leq 1$, $M \leq 1$). In these ranges the equations of motion possess real characteristics, and the shock relations have solutions which satisfy the second law of thermodynamics and are stable against one-dimensional breakup (the Akhiezer, Polovin, Lyubarskii criterion). Thus, direct comparisons of gasdynamic and magnetogasdynamic behavior can be made. By numerical solution of the shock relations, shock waves are found to be of three basic types under these conditions, depending on the upstream state (A_∞, M_∞): (1) weak field ($A_\infty \geq A_s = \sqrt{(\gamma+1)M_m^2/2 + (\gamma-1)M_m^2}$; (2) strong field ($1 \leq A_\infty \leq A_s$); and (3) sub-Alfvénic Flow ($A_\infty^2 + M_\infty^2 \geq 1$, $A_\infty \leq 1$, $M_\infty \leq 1$). Families of shock polars for each of these regions are presented. The axisymmetric flows corresponding to each of these shock types are studied by both numerical integration of the exact equations of motion and by perturbation solutions carried out to second order. The numerical solutions are for flow over a semi-infinite cone, over the range of upstream parameters ($1.05 \leq A_\infty \leq 20$, $1.05 \leq M_\infty \leq 20$) for the super-Alfvénic flows. The weak field behavior of the solutions is similar to gasdynamic behavior qualitatively, but it is found that the magnitude of perturbations of the upstream flow decreases monotonically with increasing field strength. The perturbations on the cone surface nearly vanish near the Alfvén transition (strong field flows about axisymmetric bodies must include finite stagnant regions, "slugs" fore and aft of the body, as predicted by Stewartson for sub-Alfvénic incompressible flow). No solution consisting of shock wave plus conical flow could be found in the sub-Alfvénic case due to singularities of the equations of motion at the backward-facing characteristic. A complete transcription method based on Cowley's analogy is developed to obtain second order perturbation solutions for the super-Alfvénic case from gasdynamic solutions. The method is demonstrated by transcription of Van Dyke's cone flow solution, and agreement with the numerical results is excellent, improving with increasing field strength. The perturbation solutions do not predict the super-Alfvénic slugs near Alfvén transition. A more direct perturbation solution is developed for cone flows, and is employed to demonstrate that no conical flow perturbation solution can be obtained under sub-Alfvénic conditions, thus substantiating the numerical findings. (Diss. Abstr. Int., B)

32712 SOME RESULTS OF THE EXISTENCE AND UNIQUENESS FOR NONSTATIONARY MHD FLOWS. Sanchez-Palencia, Enrique (Faculte des Sciences, Paris. Univ., Madrid). J. Mec.: 8: 509-41(Dec 1969). (In French).

The existence and uniqueness of certain MHD flows of a viscous, incompressible and electrically conducting fluid are investigated. The fluid is at rest at large distances from a body in nonuniform translational motion that started from the rest with a constant magnetic field imposed at infinity. The existence of a weak solution of the boundary-value problem is proved for both two- and three-dimensional flows and for both conducting and insulating bodies. In the two-dimensional case, the uniqueness of the solution and its continuous dependence on the data are also proven, as well as the following property: for an arbitrary fixed time, the circulations of the velocity and magnetic fields around a circle tend to zero as the radius tends to infinity. (auth)

32713 CONTRIBUTION TO THE SOLUTION OF THE DISTRIBUTION OF CHARGE IN THE CHANNEL OF A MHD GENERATOR. Pelz, P. Acta Tech. CSAV; 14: 179-80(Apr 1969).

The influence of integral charge neutrality on the local space charge density in an MHD generator was investigated. A single pair of electrons of a dc Faraday generator are considered. Equations are deduced for a quasi-one-dimensional case. Differential equations for the intensity of electric field, and for the charge density, are derived for three separate cases: that with the segment electrodes at no load, with the electrodes loaded, and the electrodes short-circuited. The corresponding space-charge distribution is then deduced; it depends on the velocity profile and on the conductivity profile of the medium. The calculation of numerical values of charge distribution would require, even for the simplest cases of velocity and conductivity profiles, the use of a computer. (NSA of Czech)

32714 EXISTENCE OF TOROIDAL MAGNETOHYDROSTATIC EQUILIBRIUM WITHOUT ROTATIONAL TRANSFORMATION. Lortz, Dietrich (Institut fuer Plasmaphysik, Garching, Ger.). Z. Angew. Math. Phys.; 21: 196-211(25 Mar 1970). (In German).

The magnetohydrostatic boundary-value problem is investigated for a toroidal boundary surface T, symmetric with respect to a plane, but which need not be continuously symmetric. The existence of an equilibrium solution is proved for the boundary condition that the magnetic field B be tangential at T. The pressure as a sufficiently smooth function of $q = \oint |B|^{-1} dl$ and the azimuthal magnetic flux can be chosen arbitrarily. (auth)

Geophysics (Upper Atmosphere)

Refer also to abstracts 32608, 32693, 32696, and 32728.

32715 (AD-689399) IONOSPHERIC RESEARCH USING SATELLITES. Annual Summary Report No. 3, October 7, 1967-October 6, 1968. Hunter, Arthur N.; Kelleher, Raymond F. (University Coll., Nairobi (Kenya). Dept. of Physics). 30 Nov 1968. Contract AF61(052)-909. 40p. (AFCRL-69-270). CFSTI.

An account is given of the analysis of satellite transmissions recorded at Nairobi, Addis Ababa and Dar es Salaam. Work was concentrated on the latitude and diurnal variation of total electron content (satellites BE-B and Canary Bird), the latitude variation of scintillation occurrence (BE-B and BE-C), and the height and size of irregularities (San Marco). (auth) (USGRDR)

32716 (AD-694587) X-RAY AND PARTICLE RADIATION AT HIGH ALTITUDES IN THE AURORAL ZONE. Final Scientific Report No. 9, April 1, 1965-March 31, 1969. Trefall, Harald (Bergen Univ. (Norway). Dept. of Physics). 30 Jun 1969. Contract AF61(052)-869. 57p. (AFOSR-69-2471-TR). CFSTI.

Balloon recordings performed from stations in Northern Norway, from 1965 to 1968, of auroral bremsstrahlung x-ray events produced by electron precipitation into the upper atmosphere in the auroral zone are summarized. The morphology and dynamics of such events were studied by means of multiple balloon flights. The character of the x-ray events was found to depend very much on the local time at which they are recorded. It appears as if acceleration and precipitation of electrons start in the midnight sector, and spread very rapidly eastward along the auroral oval. Temporarily trapped electrons then seem to drift out of the oval, and give rise to further precipitation events along the statistical auroral zone. (auth) (USGRDR)

32717 (AD-698348) STUDY DIRECTED TOWARD SIMULTANEOUS AIRGLOW AND RADIO OBSERVATIONS OF THE LOWER IONOSPHERE. Report No. Scientific-1. Hayes, Daniel P. (Lowell Technological Inst., Mass. Research Foundation). Aug 1969. Contract F19628-68-C-0259. 40p. (LTIRF-298/1-P; AFCRL-69-366). CFSTI.

Specific ways by which airglow emissions can augment ground-based radio wave propagation studies of the lower ionosphere are considered. The author is specifically concerned with demonstrating the manner in which selected airglow lines and bands provide a convenient means for monitoring those aeronomical processes which exert decisive control on the radio propagation environment. It is specifically shown how simultaneous airglow-radio experiments can augment our knowledge of the dynamics and chemistry which control both the D and E regions of the ionosphere. New findings are reported concerning the latitude cutoff of conjugate streaming photoelectrons. (auth) (USGRDR)

32718 (AD-699203) AURORAL LYMAN-ALPHA OBSERVATIONS. Clark, Malcolm A. (Aerospace Corp., El Segundo, Calif.). 25 Oct 1969. Contract F04701-69-C-0066. 31p. (TR-66(5260-10)-2; SAMSO-TR-69-396). CFSTI.

Observations were made of Lyman-alpha auroral emissions during January and February 1967. The observations were made with a narrow-band sky-scanning photometer mounted on an earth-oriented satellite in polar orbit. Auroras in the southern hemisphere were usually single in structure, and those in the north, complex. The single auroral emissions show a typical latitude spread of about 6.5°. Intensities up to 60 kR were observed at times of high magnetic activity, implying energy deposition up to 20 ergs/cm^2/sec. The intensities show a correlation with high-latitude geomagnetic activity, with a breakdown during extremely active periods. (auth) (USGRDR)

32719 (AD-699213) RESEARCH DIRECTED TOWARD THE STUDY AND ANALYSIS OF ELECTROSTATIC ANALYZER DATA. Final Report, March 5, 1968-July 15, 1969. Reidy, William P. (American Science and Engineering, Inc., Cambridge, Mass.). 15 Aug 1969. Contract F19628-68-C-0287. 190p. (ASE-2255; AFCRL-69-369). CFSTI.

The OV3-2 satellite was instrumented with two electron electrostatic analyzers to measure the auroral electron spectrum between 10 and 100 keV, the electron pitch-angle distribution, and the precipitated electron flux. The design and calibration of these instruments are documented. Real-time recordings were made at Churchill and Thule. The analysis of this data is presented, including spectral form, spatial distribution, and limited pitch-angle distributions. Aerobee rocket 15.735 was instrumented with a high-resolution rapid sweep circuit (300 milliseconds per energy sweep) to measure the auroral electron spectrum between 2 and 35 keV and a thin-window ionization chamber to measure the total energy deposition. The rocket was launched during the breakup of a visible aurora and penetrated a diffuse auroral region. The energy spectra temporal variation and the variation in pitch-angle distribution as a function of energy are presented. (USGRDR)

32720 (AD-700050) A STUDY OF THE DIURNAL VARIATIONS OF THE 5577 A (OI) AIRGLOW EMISSION AT SELECTED IGY STATIONS. Environmental Research Papers. Brenton, June G.; Silverman, S. M. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Oct 1969. 84p. (AFCRL-ERP-306; AFCRL-69-424). CFSTI.

Data obtained from the world-wide network of stations during the IGY on the emission intensity of 5577 A (OI) were used for the study of the diurnal variation. In addition to the overall diurnal variation, seasonal and sunspot cycle effects were studied and a harmonic analysis was carried out on the data. (auth) (USGRDR)

32721 (AD-700232) DISTRIBUTION OF TRAPPED PARTICLES AT AN ALTITUDE OF 900 Km NEAR THE SOUTH ATLANTIC GEOMAGNETIC ANOMALY. Kaufmann, Pierre; de Freitas Pacheco, J. A.; Sudano, J. Pantuso; Kreplin, R. W. (Naval Research Lab., Washington, D. C.). 6 Jan 1970. 14p. (NRL-6995). CFSTI.

Energetic particle responses on x-ray photometers from the NRL 1964-01-D Satellite experiment were analyzed in order to describe the zone where the regions of high-energy trapped particles are observed in the Southern Hemisphere. The particles are identified as protons from the inner Van Allen belt, and their flux is determined approximately. A description of the particle signals and their geographic distribution are presented. (auth) (USGRDR)

32722 (AD-700254) OBSERVATIONS OF 8-AMU/UNIT CHARGE ION CYCLOTRON WHISTLERS. Gurnett, Donald A.; Rodriguez, Paul (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Dec 1969. Contracts Nonr-1509(06); NAS5-10625. 13p. CFSTI.

A new type of ion cyclotron whistler associated with ions having a mass-to-charge ratio of 8-amu/unit charge is reported from vlf radio noise observations with the Injun 5 satellite. The observation confirms earlier measurements by the Explorer 31 satellite identifying the presence of 8-amu/unit charge ions in the ionosphere and represents the third type of ion cyclotron whistlers found in satellite vlf data. From crossover-frequency measurements, the fractional concentration of the 8-amu/unit charge ions was determined to be a few percent or less. This new ion cyclotron whistler was observed most often during local night at altitudes ranging from 1200 to 2100 km and invariant latitudes from 37 to 58°. (auth) (USGRDR)

32723 (AD-700804) INVESTIGATION OF ELECTRICAL STRUCTURE IN THE NEAR EARTH REGION AS MEASURED BY ORBITING SPHERICAL ELECTROSTATIC ANALYZERS, OR PLASMA PROBES. Final Report, July 1, 1968-October 31, 1969. Lieberman, Aaron; Greene, Benjamin R.; Snapp, Warren J. (Applied Systems Corp., Freeport, N. Y.). 28 Nov 1969. Contract F19628-68-C-0382. 85p. (AFCRL-70-17). CFSTI.

Experiments for the study of the distribution of charged particles in the near-Earth regions are discussed. The experiments consist of spherical electrostatic analyzers of probes, flown on OGO satellites. Scientific and numerical techniques for the study and analysis of the data produced by these experiments and a system of computer programs for converting the recorded raw data into the desired physical results are given. (auth) (USGRDR)

32724 (AD-700931) VLF MEASUREMENTS OF THE POYNTING FLUX ALONG THE GEOMAGNETIC FIELD WITH THE INJUN 5 SATELLITE. Progress Report. Mosier, Stephen R. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Jan 1970. Contracts Nonr-1509(06); NAS5-10625. 108p. CFSTI.

The direction of the Poynting flux, up or down the geomagnetic field, was determined for several types of vlf (30 Hz to 10 kHz) radio noise phenomena observed with the Injun 5 satellite, thereby

providing information about the source region of these waves and their propagation in the magnetosphere. Determinations of the Poynting flux direction of short-fractional-hop whistlers and proton whistlers show that they are propagating up the geomagnetic field in accordance with the accepted theories of these phenomena, thereby providing a good check on the experimental technique. Measurements are presented on the Poynting flux direction of subprotonospheric whistlers, periodic emissions, elf hiss, chorus, vlf hiss, and new type of emission called a saucer. (auth) (USGRDR)

32725 (AD-701011) THE CHARACTERISTICS OF A SPACE-VEHICLE-BORNE CHARGED PARTICLE SENSOR. Physical Sciences Research Papers. Smiddy, Michael; Stuart, R. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Nov 1969. 23p. (AFCRL-PSRP-400; AFCRL-69-519). CFSTI.

An expression is developed for the current flow to n spheres with known potential differences between them in a drifting Maxwellian plasma. By equating this to zero and solving the resulting equation numerically, one obtains the potential of the spheres relative to the plasma. A charged-particle sensor mounted on a space vehicle is then investigated, represented by a two-sphere system. The current-voltage characteristic produced by sweeping the potential difference between the two spheres is derived and shown to be distorted by the variation of the vehicle potential. A method of correction, introduction of a third sphere, is described. The effects of area ratio, temperature, and drift velocity are investigated. An attempt is made to use this method to throw some light on the case where the vehicle is cylindrical. The added complications owing to the attitude sensitivity of the system as soon as any electrode becomes nonspherical are immediately apparent. Finally, the implications of the theory in temperature determination from the sensor characteristic are discussed. (auth) (USGRDR)

32726 (AD-701059) MEASUREMENTS OF TRAPPED ALPHA PARTICLES: L VALUES BETWEEN 2 AND 4.5. Report for March-June 1969. Blake, J. B.; Paulikas, G. A. (Aerospace Corp., El Segundo, Calif.). 15 Nov 1969. Contract F04701-69-C-0066. 14p. (TR-66(5260-20)-9; SAMSO-TR-70-9). CFSTI.

Measurements of alpha particles and protons at L values between 2 and 4.5 are presented. The results are compared with theoretical predictions of the relative abundances of protons and alpha particles and the spatial location of peak intensities. (auth) (USGRDR)

32727 (AD-701868) D-REGION ELECTRON DENSITY MEASUREMENTS DURING THE SOLAR ECLIPSE OF NOVEMBER 12, 1966. Lootens, Harold T.; Dean, William A. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Jan 1970. 29p. (BRL-1464). CFSTI.

Under the sponsorship of the Defense Atomic Support Agency (DASA), and in cooperation with the Brazilian Space Commission (CNAE), the National Aeronautics and Space Administration (NASA) and Sandia Corporation, the Ballistic Research Laboratories (BRL) instrumented and launched five Nike-Javelin III rockets from the southeastern coast of Brazil before and during the total solar eclipse of November 12, 1966. Each payload carried a nose-tip Langmuir probe for electron density and temperature measurements, two receivers to provide data for a partial reflection experiment and for differential absorption measurements, and a parachute-borne probe (ejected from the payload at apogee) for positive and negative charge conductivity measurements. Electron densities derived from the Langmuir probe are presented as a function of time and altitude during the eclipse. (auth) (USGRDR)

32728 (N-69-39662) PREDICTION OF GEOMAGNETIC ACTIVITY. Moe, Kenneth; Crooker, Nancy U. (McDonnell Douglas Astronautics Co., Santa Monica, Calif.). Aug 1969. Contract NAS8-30156. 46p. (NASA-CR-61306). CFSTI.

The predictive capability of several newly available tools is evaluated. The study includes solar wind speed, PCA spectra energetic electrons, interplanetary field direction, and the study of the perpendicular fluctuations of the interplanetary field. These measurements are introduced into a mathematical formulation to predict the contributions to geomagnetic disturbance of persistent streams and flare-associated streams of solar plasma. (auth) (STAR)

32729 (N-70-12926) OBSERVATIONS OF IRREGULAR STRUCTURE IN THERMAL ION DISTRIBUTIONS IN THE DUSK-SIDE MAGNETOSPHERE. Taylor, H. A.; Brinton, H. C.; Deshmukh, A. R. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Dec 1969. 29p. (NASA-TM-X-63754; X-621-69-519). CFSTI.

Direct measurements of the distributions of the thermal positive ions H^+ and He^+ in the magnetosphere reveal a distinct variability in the position and structure of the plasmapause. Such variability is observed to be most pronounced in the afternoon-dusk local time sector and is indicative of magnetospheric irregularities in the same region. In particular, the plasmapause was observed at L positions as distant as L = 7 to 8 in the afternoon-dusk sector, in contrast to positions near L = 5 to 6 observed near midnight on the same day and at comparable levels of moderate magnetic activity. Both a dusk-side bulge and fine structure are observed to persist during periods of enhanced magnetic activity. The above variability is superimposed on an average diurnal distribution of the plasmapause. The evidence of the plasma bulge and the associated plasma fluctuations is generally consistent with magnetospheric convection models proposed by Nishida and by Brice. (auth) (STAR)

32730 (N-70-14217) D REGION RADIO MEASUREMENTS AT THE MAGNETIC EQUATOR. Kane, J. A. (National Aeronautics and Space Administration, Goddard Space Flight Center). Nov 1969. 16p. (NASA-TM-X-63761; X-615-69-499). CFSTI.

Electron density measurements are reported from two ARCAS rocket flights at Thumba, India on March 8, 1968. D region electron density profiles were obtained from absorption measurements of cw radio transmissions propagating transversely to the Earth's magnetic field. (auth) (STAR)

32731 (N-70-14257) MAGNETIC FIELD FLUCTUATIONS IN THE MAGNETOSHEATH OBSERVED BY PIONEER 7 AND 8. Mariani, F.; Bavassano, B.; Ness, N. F. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Dec 1969. 35p. (NASA-TM-X-63762; X-616-69-541). CFSTI.

Fluctuations of the magnetic field at frequencies less than 0.05 Hz were studied in the magnetosheath from data obtained by Pioneers 7 and 8. During the first two weeks of their flight, the probes were in similar trajectories along approximately radial directions from the earth. Magnetic fluctuations inside the magnetosheath are essentially transverse to the field vector and the most excited field component is perpendicular to the ecliptic plane. The entire spectrum is excited. The magnetic energy associated with the fluctuations is found to exponentially decay with increasing distance transverse to the Sun-Earth line. These results suggest that the fluctuations represent an enhanced microstructure produced by the amplification of small convected irregularities occurring at the bow shock. (auth) (STAR)

32732 INTERPRETATION OF D-REGION ELECTRON DENSITIES. Sechrist, C. F. Jr. (Univ. of Illinois, Urbana). Radio Sci.; 5: 663-71(Apr 1970).

D-region electron densities measured by rockets during the November 12, 1966, solar eclipse are shown to imply an effective recombination coefficient at an altitude of about 80 km of the order of 10^{-5} cm^3 sec^{-1}. The D-region electron densities between 65 and 83 km are computed for full-sun conditions assuming this value of recombination coefficient, the [3^+] profile of Narcisi and Bailey [1965], and the NO profiles of Barth [1966], Pearce [1969], and Hesstvedt and Jansson [1969]. Electron densities between 60 and 65 km are estimated on the basis of the above-mentioned NO profiles and the negative-ion model of LeLevier and Branscomb [1968]. Also, electron densities between 80 and 90 km are computed by assuming an effective electron-ion recombination coefficient for NO^+ and O_2^+ of 10^{-6} cm^3 sec^{-1}. There is a reasonable agreement between the computed electron densities and those measured by rockets launched from Wallops Island near 60° solar zenith angle. These results suggest that variability of D-region electron densities may be caused by changes in H_2O vapor concentration induced by atmospheric circulation or eddy-transport effects. (auth)

32733 CHARACTERISTICS OF THE SPORADIC E LAYER AT WALTAIR USING THE PHASE PATH TECHNIQUE. Reddi, C. Raghava; Rao, B. Ramachandra (Andhra Univ., Waltair, India). Radio Sci.; 5: 679-83(Apr 1970).

The E_s-echo phase-path records on 5.6 MHz have shown that the bottom surface of the E_s was sometimes very sharply bounded. Some evidence showing that the formation of E_s is a highly localized phenomenon has been obtained. The phase-path variations of "O" and "X" components in the F2-region echo during the formation of E_s showed that the increase in the ionization in the E_s is not totally from a vertical redistribution of the ionization along the ray paths. From spaced phase-path records of E_s echoes taken during the daylight hours, apparent drift speeds in the range 40 to 130 m/sec with an eastward sense of the east-west components of E_s apparent drifts were observed. This is opposite to the sense of the east-west components of E-region drifts during the daylight hours, but is the same as that during the nighttime hours. An attempt is made to interpret these observations. (auth)

32734 COMPARISON OF ELECTRON DENSITY PROFILES OBTAINED FROM BACKSCATTER OBSERVATIONS AND IONOGRAM ANALYSIS. Smith, D. H. (Cornell Univ., Ithaca, N. Y.). Radio Sci.; 5: 685-92(Apr 1970).

A large number of ionograms recorded at Arecibo were converted to electron density profiles. It is shown that the method of analysis can give very high accuracy for a single layer, but the presence of an E layer can result in systematic errors in the shape of the F layer. Backscatter observations taken at the same times as the ionograms were analyzed to give electron density curves with a height resolution of 9 km. Although there is a wide range of variation in the shape and height of the ionospheric layers, there is, in general, close agreement between the profiles obtained by the two methods. (auth)

32735 NOTE ON THE APPLICABILITY OF THE BOOKER THEOREM TO MAGNETOACTIVE PLASMAS. von Roos, Oldwig (Astrophysics Research Corp., Los Angeles). Radio Sci., 5: 693-5(Apr 1970).

It is shown that a recently found theorem (Booker et al., 1968) relating the reflection coefficients for electromagnetic scattering from a variety of stratified media to each other in a simple way is inapplicable in cases where a static magnetic field is present. Calculations of vlf propagation in the lower ionosphere can, therefore, not be simplified by a utilization of the above-mentioned theorem. (auth)

32736 PLASMA MOMENT EQUATIONS IN A DIPOLE FIELD. Grebowsky, J. M. (Goddard Space Flight Center, Greenbelt, Md.). Radio Sci.; 5: 601-4(Mar 1970).

A coordinate system is defined with respect to a magnetic dipole field configuration by unit vectors in the direction of the field, in the azimuthal direction, and along the line of intersection of the local magnetic meridian plane with the local equipotential surface of the magnetic dipole. The velocity terms of the continuity and momentum equations pertinent to plasma motion are expressed in terms of variations along these coordinate directions. (auth)

32737 PROPAGATION AND GROUP VELOCITY IN A WARM MAGNETOPLASMA. Aubry, M. P.; Bitoun, J.; Graff, Ph. (Centre National de la Recherche Scientifique, Issy-les-Moulineaux, France. Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). Radio Sci.; 5: 635-45(Mar 1970).

The full adiabatic theory is used to describe wave propagation in a warm magnetoplasma for frequencies around the plasma frequency and the upper hybrid resonance frequency. By comparison with the microscopic theory for directions perpendicular and parallel to the static magnetic field, the range of validity of the full adiabatic theory can be defined and can then be used for computation of the group velocity. The variation of this group velocity as a function of frequency for several directions of propagation is shown for models corresponding to the ionosphere and the far magnetosphere. Three factors deserve attention: (1) the upper hybrid resonance and its neighborhood can be rigorously studied for far magnetospheric conditions by using the full adiabatic theory; (2) the computed modes present a mixed electrostatic–electromagnetic character; (3) the minima in group velocities for pseudoresonance frequencies progressively fill up as the temperature increases. (auth)

32738 PIONEER 8 ELECTRIC FIELD MEASUREMENTS IN THE DISTANT GEOMAGNETIC TAIL. Scarf, F. L. (TRW Systems Group, Redondo Beach, Calif.); Green, I. M.; Siscoe, G. L.; Intriligator, D. S.; McKibbin, D. D.; Wolfe, J. H. J. Geophys. Res.; 75: 3167-79(1 Jun 1970).

The Pioneer 8 space probe encountered the extension of the geomagnetic tail in January of 1968, at downstream distances of 500 to 800 R_E. During this period the vlf electric-field experiment sporadically detected some characteristic changes in the plasma-wave noise spectrum that appeared in close association with tail-like positive ion energy spectra. The Pioneer 8 wave and particle observations are correlated in detail and it is shown that during the extended tail crossings the average broadband wave levels were reduced. Enhanced 400-Hz activity was frequently detected near the tail boundaries, however, and the observations suggest that tail breakup and field-line reconnection phenomena begin to be important within 500 R_E. (auth)

32739 DEFORMATION OF A MAGNETIC DIPOLE FIELD BY TRAPPED PARTICLES. Lackner, K. (European Space Research Inst., Frascati, Italy). J. Geophys. Res.; 75: 3180-92(1 Jun 1970).

A model for the stormtime ring current, based on a self-consistent steady-state solution of Vlasov's and Maxwell's equations for a finite-pressure plasma immersed in the Earth's dipole field, is described. The particular choice of the particle distribution function is justified by the good fit to OGO 3 particle energy density and the Explorer 26 magnetic-field measurements made during moderate geomagnetic storms. The model is then used to calculate a set of self-consistent equilibrium configurations that correspond to increasing dipole moments of the ring current. These calculations prove the existence of equilibrium solutions that contain a neutral point and regions in which the particle energy density exceeds the undisturbed magnetic-field energy density for a factor of up to 27. For a given shape of the particle distribution function in field-line space, it is shown that the particle-energy density, the total confined particle energy, and the disturbance field on the earth's surface are limited. For a particle distribution centered around the field line with the shell coordinate $L = 3.3$ in the undisturbed state, these limiting values were found to be 1.55×10^{-6} ergs/cm^3, 5.2×10^{22} ergs, and -230 γ, respectively, where the dependence of these results on the shell coordinate of the undisturbed center field line follows simple scaling laws. (auth)

32740 IN SITU MEASUREMENTS OF NEUTRAL AND ELECTRON DENSITY WAVE STRUCTURE FROM THE EXPLORER 32 SATELLITE. Dyson, P. L.; Newton, G. P.; Brace, L. H. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res.; 75: 3200-10(1 Jun 1970).

In situ measurements of neutral particle and electron density from the Explorer 32 satellite have provided direct evidence that gravity waves in the thermosphere are associated with wave-like structure in the F-region electron density. The ionospheric wave structure amplitude and spatial extent are consistent with those characteristics for travelling ionospheric disturbances (TID). Although the observed neutral and electron-density wave structures are often out of phase, in some cases there was no correlation between the waves. Because of the lack of observation of all of the required ionospheric and neutral-wave characteristics, it is not possible to quantitatively interpret the observed phase relationships. However, the observed amplitudes of the wave structure (±10 to ±30% in electron and neutral density) are consistent with theoretical expectations. In the one case where the electron temperature structure could be studied, the electron temperature was out of phase with the electron density. The phase relationship between the electron density and temperature wave structure probably results from local cooling effects in the ionospheric plasma. (auth)

32741 FORMATION OF STRIATIONS IN IONOSPHERIC PLASMA CLOUDS. Linson, Lewis M.; Workman, Joseph B. (Avco Everett Research Lab., Everett, Mass.). J. Geophys. Res.; 75: 3211-19(1 Jun 1970).

It is suggested that a low-frequency "gradient drift" instability may be important for the formation of striations in barium ion clouds released in the ionosphere above the E layer. The theory predicts that the trailing edge (with respect to the neutrals) of the plasma cloud will be unstable while the leading edge is stable, in qualitative agreement with observations. The growth time is relatively independent of wavelength and is of order d/U_0, where d is the typical density gradient length and U_0 is the velocity of the cloud with respect to neutrals. Predicted growth times varying from seconds in the auroral zone at high latitude to minutes at midlatitudes are also in agreement with observation. Wavelengths of waves with zero phase velocity are found to be given approximately by $\lambda = 2\pi d$, which can be verified by optical observations. (auth)

32742 MODEL CALCULATION OF THE DIURNAL VARIATION IN MINOR NEUTRAL CONSTITUENTS IN THE MESOSPHERE AND LOWER THERMOSPHERE INCLUDING TRANSPORT EFFECTS. Shimazaki, Tatsuo; Laird, A. R. (ESSA Research Labs., Boulder, Colo.). J. Geophys. Res.; 75: 3221-35(1 Jun 1970).

The nonequilibrium calculation for various neutral constituents in the mesosphere and lower thermosphere (Hunt, 1966) was extended by including the effects of molecular and eddy diffusion. Nitrogen and its oxides were added, and more recent laboratory data for chemical reaction coefficients were used. A special numerical technique has been developed to simultaneously solve time-dependent continuity equations for 14 constituents. The preliminary result indicates that vertical eddy diffusion significantly reduces the irregular variations around 80 km and tends to lower the height of these irregular variations. However, the value of the eddy diffusion coefficient acceptable from the consideration of heat balance below ~100 km cannot entirely smooth out these irregular distributions for atomic oxygen, ozone, and oxygen–hydrogen compounds, although the smoothing effect for nitric oxide seems to be strong enough to eliminate the irregular variations above ~70 km. The role of the transport terms for molecular and eddy diffusion in the continuity equation is illustrated explicitly and discussed for some

representative cases. It is shown that the dynamic model fits the observational results for ozone and nitric oxide concentrations better than the static model and also offers a more adequate explanation for the observed diurnal variation in the OH airglow emission. (auth)

32743 ATTENUATION OF ENERGETIC ELECTRONS AND IMPACT IONIZATION IN THE IONOSPHERE. Prasad, R. Y.; Singh, R. N. (Banaras Hindu Univ., India). Earth Planet. Sci. Lett.; 8: 169-72(Apr 1970).

Attenuation of energetic electrons in the energy range 1 to 300 keV precipitating in the ionosphere was calculated and the resulting height profile in the range 50 to 300 km is shown. The impact ionization produced by precipitating electrons of energy 3 to 300 keV was calculated and its height profile is shown. It is seen that impact ionization increases with increasing energy of precipitating electrons. High-energy electrons penetrate deeper into the ionosphere and produce a high degree of ionization. (auth)

32744 FREQUENCY VARIATIONS OF SCHUMANN RESONANCES. Galejs, Janis (Sylvania Electronic Systems, Waltham, Mass.). J. Geophys. Res.; 75: 3237-51(1 Jun 1970).

The resonances of the Earth-to-ionosphere cavity are analyzed by considering the different propagation characteristics of day and night hemispheres. The azimuthal unsymmetries cause mode splitting, but the amplitudes of these additional split modes appear to be negligible for normal conditions. Diurnal variations of the resonance frequencies of the vertical electric field differ from the frequency variations of the horizontal magnetic field. The electric field resonance frequencies can explain the complete diurnal variation of the measured fundamental resonance if local equatorial thunderstorm activity, which peaks in late afternoon over land, is changed to a variation, which peaks at night for sources over the Pacific. The frequency variations are caused by the interaction of adjacent resonance modes. An eccentric geomagnetic field may cause comparable frequency changes if the nighttime phase velocity is decreased with an increasing magnitude of the radial geomagnetic field component. Such a phase velocity variation is not observed for nighttime ionosphere models that account for various F-layer altitudes. (auth)

32745 VARIATION OF THE MAGNETOPAUSE POSITION WITH SUBSTORM ACTIVITY. Meng, C. I. (Univ. of California, Berkeley). J. Geophys. Res.; 75: 3252-4(1 Jun 1970).

Locations of the magnetopause near the noon meridian observed by the IMP 2 satellite are compared with the polar substorm activity indicated by the hourly AE index. It is found that a distended magnetosphere is associated with geomagnetic quiet conditions (low AE values). When polar substorms are in progress, the magnetosphere is in a compressed condition. (W.D.M.)

32746 PARTICLE ACCELERATION BY ELECTROSTATIC WAVES PROPAGATING IN AN INHOMOGENEOUS PLASMA. Laval, G.; Pellat, R. (Departement d'Etudes et de Recherches en Technologie Spatiale, Toulouse). J. Geophys. Res.; 75: 3255-6 (1 Jun 1970).

Swift (1968) has suggested that an efficient accelerating process for electrons could be provided by electrostatic waves that propagate downward in the inhomogeneous plasma of the upper ionosphere. These waves would be excited by anisotropies in the distribution function of the ring current. Numerical computation by Gary et al. [1968] showed that this conjecture is correct: if the phase velocity of the waves increases, a few particles may remain trapped in the potential wells of the waves, and their velocities would then be multiplied by a factor of 4 in the chosen example. It is demonstrated that these results can be obtained by analytically studying the motion of particles in the wave field. Conditions for acceleration is given in terms of rate of increment of the phase velocity, the magnetic field gradient, and the amplitude of the wave. (W.D.M.

32747 REFLECTION OF TRANSIENT VLF SIGNALS FROM A STRATIFIED MAGNETO-IONIC MODEL OF THE IONOSPHERE. Reck, Robert Higley. Denver; Univ. of Denver (1969). 71p.

Thesis.

A method for calculating the first hop skywave of a vlf transient signal at a short distance from the source is presented, using the recorded groundwave and a stratified model of the inhomogeneous anisotropic ionosphere. The Earth's magnetic field is included in the analysis. Waveforms calculated assuming the ionospheric profiles of other investigators are compared to one skywave recorded 200 km from the source. A D-region electron density profile is determined by synthesis of the recorded skywave. A lower bound for the collision frequency at 70 km is determined. The analysis shows that reflection occurs mainly from a quasi-isotropic region of the ionosphere. The ionospheric profiles determined by the synthesis procedure are compared to those of other investigators. (Diss. Abstr. Int., B)

32748 IONOSPHERIC EFFECTS OF X RAYS FROM SCORPIO X-1 AND TAURUS X-1 (CRAB). Ananthakrishnan, S.; Chakravarty, S. C.; Ramanathan, K. R. (Physical Research Lab., Ahmedabad, India). Proc. Indian Acad. Sci., Sect. A; 71: 69-81 (Feb 1970).

Ananthakrishnan and Ramanathan (1969) considered an effect of x rays from Tau X-1 and Sco X-1 on the nighttime field strength of 164 kHz radio waves transmitted from Tashkent to Ahmedabad. This problem is discussed in greater detail. The first section deals with observational aspects of the effect of x rays from Sco X-1, the second is devoted to an examination of the effect of two other x-ray sources on the nighttime field strength, and the final section is concerned with a comparative study of the x-ray spectra of Sco X-1, Tau X-1, and the quiet Sun during periods of high and low activity. Also included are calculations of ion production and the resulting electron density due to these x-ray sources. (W.D.M.)

32749 NEUTRAL POINTS AND MAGNETIC-FIELD RECONNECTION. Sonett, C. P. (Ames Research Center, Moffett Field, Calif.). Comments Astrophys. Space Phys.; 1: 87-93(May-Jun 1969).

In solar flares the principal problems are how to explain the large energy release and the short time scale. In magnetospheric physics reconnection of magnetic-field lines shares importance with the energy exchange process. Reconnection involves the topological properties of the magnetic field; open and closed volumes exist identified with different flux tubes, and they are separated by singular sheets of field lines which end on null points, lines, or surfaces. The motivation for this type of description is that in plasmas where curl H is permitted to differ from zero generally in the field, interchange of flux tubes between open and closed parts of the field becomes possible. (W.D.M.)

32750 DEPENDENCE OF THE CUTOFF FREQUENCY OF THE E_s LAYER ON SOLAR ACTIVITY. Samardzhiev, D. Compt. Rend. Acad. Bulg. Sci.; 23: 53-6(1970). (In Russian).

The author has examined the sporadic E layer during periods of change in the solar activity and during the May 20, 1966 solar eclipse. The problem is studied again, making use of additional experimental material collected at ten vertical ionization probing stations located at various latitudes. The state of the ionization of the E_s layer was derived from the monthly variations of the cutoff frequency, fE_s while the solar activity was followed on the basis of data received from the Zurich observatory. A positive, linear correlation could be established between the cutoff frequency and of the sporadic layer and the solar activity. (TTT)

32751 LATITUDE VARIATION OF RADAR AURORA WITH LOCAL SUBSTORM ACTIVITY. Harris, F. R.; Kavadas, A. (Univ. of Saskatchewan, Saskatoon). Can. J. Phys.; 48: 1411-14(1 Jun 1970).

Radio aurora detected at Prince Albert advances farther south with increasing magnetic activity. The latitude vs. magnetic activity relation for radio aurora is compared with similar relations for ionospheric currents. The effect of aspect sensitivity is discussed. (auth)

32752 THEORY OF GENERATION OF BOW-SHOCK-ASSOCIATED HYDROMAGNETIC WAVES IN THE UPSTREAM INTERPLANETARY MEDIUM. Barnes, Aaron (Ames Research Center, Moffett Field, Calif.). Cosmic Electrodyn.; 1: 90-114(Apr 1970).

A theoretical model is presented of the generation of hydromagnetic waves observed upstream of, but associated with, the Earth's bow shock. Analysis of the stochastic acceleration of protons observed streaming from the shock into the upstream interplanetary medium indicates that these particles can generate hydromagnetic waves through ion-cyclotron resonance. This instability is quenched by wave-particle momentum exchange (pitch-angle scattering), which is more efficient than wave-particle energy exchange by the ratio of the Alfvén speed to the streaming speed C_A/V_b ($\ll 1$); hence only the fraction C_A/V_b of the streaming energy is available for conversion to wave energy. This fraction of the observed proton streaming energy is adequate to account for the waves observed upstream of the shock, and the computed growth rates, although rather uncertain, are consistent with the fact that the waves and the proton stream are found far upstream of the shock. This model suggests that the proton stream should be strongest near the nose of the shock, and the wave turbulence strongest on the dawn-side wing of the shock. The ways in which this wave-generation mechanism may be related to turbulence in the magnetosheath are discussed. (auth)

32753 SOLAR WIND INTERACTIONS: HYPERSONIC ANALOGUE. Dryer, Murray (ESSA Research Labs., Boulder, Colo.). Cosmic Electrodyn.; 1: 115-42(Apr 1970).

The steady-state fluid continuum technique, sometimes called

the "hypersonic analog," to predict the average properties of the solar-wind plasma as it flows around the Earth's magnetosphere has now been verified by experimental observations. This technique has also been used to infer upper limits for the magnetic fields of Venus and Mars on the basis of field and particle data from several spacecraft. Similar missions are under consideration for Jupiter, Saturn, Mercury, and Uranus. A review of the outstanding interaction characteristics observed at Earth, Moon, Venus, and Mars suggests that future observations might be predicted in a very general way by considering the "Knudsen number" for each of these celestial bodies, including comets. This nondimensional number, borrowed from ordinary fluid mechanics, characterizes the interaction—continuum, rarefied, or "transitional"—on the basis of the ratio of the fluid characteristic length to the obstacle's diameter. The inviscid steady-state fluid model is extended to include the hypothesized viscous magnetopause. The restricted case of a tangential discontinuity with parallel magnetosheath and geomagnetic fields is utilized to estimate the energy input to the magnetosphere by momentum transfer. The discussion is extended to the time-dependent interaction problem. A solar-flare-generated shock wave that propagates to the obstacle under investigation is considered. The nature of the disturbed solar-wind plasma, together with the energy distributed to it by the shock wave, is discussed. Of particular interest is the description of the interaction of the interplanetary shock wave with the standing shock wave which surrounds the obstacle. (auth)

32754 STRUCTURE OF THE INNER MAGNETOSPHERE. **Russell, Christopher T.; Thorne, Richard Mansergh (Univ. of California, Los Angeles). Cosmic Electrodyn.; 1: 67-89(Apr. 1970).**

The morphology of the thermal and energetic particles in the inner magnetosphere are investigated. The motion and relative position of several well-defined features of the particle distribution are followed during geomagnetic disturbances and over the solar cycle. It is found that ring-current protons build up just outside the storm-time plasmapause and subsequently decay at a rate such that their flux maximum approximately coincides with the expanding plasmapause. Low-energy electrons also appear just outside the plasmapause during the main phase of the storm. Their subsequent decay is much slower than that of the protons and the net effect of the storm is an injection of these electrons well into the plasmasphere. Even during periods of severe geomagnetic disturbance, the energetic electrons are distributed into two distinct zones. The pronounced and persistent slot between the inner and outer electron zones is better defined and occurs at lower L values for higher electron energies. The profile of the inner edge of the slot remains unchanged during geomagnetic storms and it also appears to be unaffected over the solar cycle. By adopting the view that the electrons are removed from the plasmasphere by the pitch-angle diffusion associated with the natural instability of the radiation belts, it is shown that the stable inner edge of the slot agrees with the location where this interaction between electrons and vlf waves becomes ineffective. The outer edge of the slot is probably controlled by a balance between inward diffusion and loss. (auth)

32755 FIELD-ALIGNED CURRENTS IN THE MAGNETOSPHERE. **Wolf, R. A.; Dessler, A. J. (Rice Univ., Houston, Tex.). Comments Astrophys. Space Phys.; 1: 117-21(Jul-Aug 1969).**

Field-aligned currents constitute the primary mechanism by which the ionosphere communicates with the magnetosphere and the solar wind. Field-aligned currents connecting the polar cap with the magnetospheric boundary and tail apparently cause a large-scale dawn-to-dusk electric field—the basic electric field that controls the flow of plasma through the magnetosphere. In this note, however, concern is primarily with another, but related, set of currents, the Birkeland currents, that travel along auroral-zone field lines, bringing to the ionosphere information about the pressure in the plasma sheet. (W.D.M.)

32756 ELECTRONS AND PROTONS IN THE EARTH'S MAGNETOSPHERE. **Vette, James I. (Goddard Space Flight Center, Greenbelt, Md.). Trans. Amer. Nucl. Soc.; 13: 415(Jun-Jul 1970).**

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32757 DAILY VARIATION OF THE GEOMAGNETIC FIELD AT THE DIP EQUATOR. **Nair, K. N.; Rastogi, R. G.; Sarabhai, V. (Physical Research Lab., Ahmedabad, India). Nature (London); 226: 740-1(23 May 1970).**

The range ΔH_A of the daily variation of the horizontal component of the geomagnetic field at Alibag(A), a low-latitude station outside the influence of the equatorial electrojet, is largely due to weakening of the ambient field on the night side rather than enhancement on the day side. The effect may be due to a magnetospheric drift current which, being more than 30,000 km above the surface of the Earth, would produce almost identical effects at Alibag and Trivandrum(T) situated on the dip equator 1,100 km south of Alibag, if differences in the induced field arising from local ground conditions are ignored. On the other hand, the well-known enhancement of ΔH at the dip equator is caused by the influence of the equatorial electrojet. Consequently $\Delta H_T - \Delta H_A$ must be related to purely ionospheric currents. The validity of these assumptions is examined, since they contradict the dynamo theory, which suggests that the contribution of the ionospheric currents should predominate at both stations on days that are not geomagnetically disturbed. The relative contribution of the two processes at Trivandrum and Alibag is estimated. Regular measurements of the electron drifts in the E and F regions of the ionosphere were made in the vicinity of Trivandrum, and the mean drift speed between 1,100 and 1,300 hr correlated well with $\Delta H_T - \Delta H_A$. Electron and ion currents in the F region would produce equal and opposite magnetic effects and therefore the correlation of $\Delta H_T - \Delta H_A$ with F-region electron drifts indicates that the latter are correlated with the E-region drifts. It is concluded that the contribution to ΔH_T at Trivandrum, which can be unambiguously attributed to an ionospheric current, remains largely unaffected by the magnetospheric contribution at both Trivandrum and Alibag. This supports the contention that two independent processes are operating. The results also support the view that drift velocities measured by the technique of spaced aerials are related to the velocity of electrons in the electrojet. (UK)

32758 INVESTIGATION OF TRANSIENT MAGNETOSPHERIC CURRENT SHEETS AS GENERATORS OF MAGNETOHYDRODYNAMIC WAVES AND GEOMAGNETIC MICROPULSATIONS. **Green, Arthur Wallace Jr. Fort Worth, Tex.; Texas Christian Univ. (1969). 138p.**

Thesis.

Spectral analysis of micropulsation data from the Dallas Geomagnetic Center and other sites indicates that on geomagnetically quiet days Pc3 and Pc4 micropulsations exhibit an occurrence maximum near local noon and a shift toward longer periods with an increase in the latitude of the observer. Similar analysis of Pi2 pulsations shows an occurrence maximum near local midnight and no latitudinal dependence of oscillation period. Observed Pc3, Pc4, and Pi2 oscillation periods are such, that for quiet geomagnetic conditions, a mid-latitude observer should note a day-to-night shift toward significantly longer periods. It is shown that analysis based on the transmission of white-spectrum MHD waves through a layered ionosphere model does not seem to yield a period shift in the direction actually observed. A new mechanism for the generation and transmission of MHD waves that would produce Pc3, Pc4, and Pi2 micropulsations is proposed. This model explicitly considers a number of recently observed magnetospheric features. An analysis of the model, including the spatial, spectral, and temporal characteristics of expected micropulsations is presented, and measurables such as power spectra, diurnal trends, and latitude dependence are compared with actual data. (Disser. Abstr. Int., B)

32759 DEPOSITION OF MAGNETOSPHERIC ELECTRONS INTO THE EARTH'S UPPER ATMOSPHERE. **Craven, John Delano. Iowa City, Iowa; Univ. of Iowa (1969). 250p.**

Thesis.

Observations of the energy fluxes of $\gtrsim$5-keV electrons over the northern auroral regions at ~530- to 2500-km altitude were obtained from February 1965 through July 1966, during a period of minimum solar activity, by means of the nearly polar orbiting satellite Injun 4. Quantitative comparisons of the percentages of occurrence of the fluxes of $\gtrsim$40-keV electrons precipitating into the earth's upper atmosphere, with corresponding percentages of occurrence for the absorption of cosmic radio noise at ionospheric altitudes below the precipitating $\gtrsim$40-keV electrons, at auroral latitudes, have shown that they generally agree to within a factor of 2. The results of the first detailed survey of the percentages of occurrence of the energy fluxes of $\gtrsim$5-keV electrons at nearly all local times and at latitudes greater than ~45° are graphically displayed for various energy flux thresholds. The greatest median energy fluxes were observed at auroral latitudes $\Lambda \simeq 60$ to 70°, through the morning hours of local time, from ~22 hours to ~10 hours. Peak energy fluxes in excess of ~20 ergs $(cm^2\text{-sec-sr})^{-1}$ were observed during geomagnetic storms. For energy fluxes $\gtrsim$0.5 ergs $(cm^2\text{-sec-sr})^{-1}$, the angular distributions were generally isotropic over the upper hemisphere. The differential intensity spectrum in the energy range ~5 to 50 keV was observed to soften with increasing geomagnetic activity. A comparison of the median energies supplied to the earth's upper atmosphere by

≳5-keV electrons, with numerical estimates of the quantities of energy required in order to produce the observed average temporal features of exospheric temperature increases during geomagnetic storms, indicates that the quantities of energy deposited by these electrons represent a significant contribution to the total energy deposited in the atmosphere. (Disser. Abstr. Int., B)

32760 INVESTIGATION OF AURORAL PHENOMENA BY SOUNDING ROCKET. Potter, Wentworth Edwards. Durham, N. H.; Univ. of New Hampshire (1969). 222p.
Thesis.

Auroral phenomena are discussed in light of previous experimental results and theoretical considerations. It is seen that visible aurora are only part of what is termed a magnetospheric substorm. The substorm phenomena include not only localized auroral zone events but also plasma convection and current systems far out into the magnetosphere. Auroral phenomena include charged-particle precipitation down magnetic field lines into the ionosphere, magnetic disturbances due to electrojet currents, electric fields that drive the electrojet, and the visible aurora. Several theories of magnetospheric substorms are investigated. The construction and testing of five Nike Tomahawk sounding rocket payloads and measurements using them are discussed. These measurements, along with ground station magnetometer records, radar data, and all-sky camera pictures were used to construct a model of the electrojet current system at the time of the flight. The results from five rocket flights are presented. Electric fields perpendicular to the magnetic field were measured. There was no appreciable altitude dependence in the fields indicating, to first order, that the magnetic field lines were equipotentials. Charged-particle flux measurements showed particle precipitation existed during periods of visible auroral activity. A correlation between an increase in luminosity and an increase in flux was noticed. Particle precipitation was also indicated on ground-based riometers. (TSS) (Disser. Abstr. Int., B)

32761 VLF RADIATION RESISTANCE OF AN ELECTRIC DIPOLE IN A COLD MAGNETOPLASMA. Wang, T. N. C.; Bell, T. F. (Stanford Univ., Calif.). Radio Sci.; 5: 605-10 (Mar 1970).

By using full-wave theory, an analysis is made of the radiation resistance of a short filamentary electric dipole, oriented with an arbitrary angle with respect to the static magnetic field, in a cold, uniform magnetoplasma. The frequency range considered lies below the local lower hybrid resonance frequency and above the proton gyrofrequency and, in this range, approximate closed-form expressions for the radiation resistance are obtained by using a plasma model appropriate to the magnetosphere. These closed-form expressions are valid for dipoles of moderately restricted length, and the physical implications of this length restriction are discussed. It is found that the radiation resistance R increases rapidly as ϕ_0, the angle of dipole orientation with respect to the magnetic field, varies from 0 to 30° but only gradually as ϕ_0 varies from 30 to 90°. The ratio of $R(\phi_0 = 90°)/R(\phi_0 = 0°)$ is approximately equal to $(f_{He}/f)^2$. Except for the case of parallel orientation and $f < 10^{-2} f_{He}$, the radiation resistance of an electric dipole in the magnetoplasma is ~10^2 to 10^5 times larger than that in free space. Thus, for the low-frequency range considered, an electric dipole in the magnetoplasma is generally much more efficient that it would be in free space. (auth)

Low-Temperature Physics

Refer also to abstracts 31759, 32466, 32926, and 32929.

32762 (ORNL-4526, pp 76-83) LOW-TEMPERATURE PROPERTIES. (Oak Ridge National Lab., Tenn.).

COPPER—thermal capacity measurements at 2 to 20°K
CYANIDES—effects on resonant phonon absorption in potassium chloride
LITHIUM FLUORIDES—neutron retention in gamma-irradiated crystals of lithium-7-enriched, search for
LITHIUM IONS—effects on resonant phonon absorption in potassium chloride
NEUTRONS—retention in gamma-irradiated lithium-7 fluoride crystals, search for
NEUTRONS, FAST—effects on superconducting niobium
NIOBIUM—magnetic behavior of neutron-irradiated superconducting, in alternating field
—superconducting critical current, effects of fast neutron irradiation on
POTASSIUM CHLORIDES—phonon resonant absorption in irradiated doped
TECHNETIUM NITRIDES—superconducting transition (D.L.C.)

32763 FLUCTUATION EFFECTS IN ZERO DIMENSIONAL SUPERCONDUCTORS. Maki, K.; Hurault, J. P.; Beal-Monod, M. T. (Faculte des Sciences, Orsay, France). Phys. Lett.; 31A: 526-7(18 May 1970).

The effect of the time-dependent fluctuations of the order parameter in superconducting samples whose dimensions are smaller than the coherence length is discussed. (auth)

32764 INFLUENCE OF THE SUPERCONDUCTING STATE ON THE CREEP OF METALS. Gindin, I. A.; Lazarev, B. G.; Lebedev, V. P.; Starudobov, Ya. D. (Inst. of Technical Physics, Kiev). JETP Lett. (USSR) (Engl. Transl.); 11: 188-90(20 Mar 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 288-90(20 Mar 1970).

It has been shown previously that niobium or lead loses strength on going over from the normal to the superconducting state, owing to the increase of energy scattered by the moving dislocations. The presence of these phenomena is verified in indium, thallium, mercury, and tin under creep conditions at temperatures from 1.8 to 4.2°K. (M.H.R.)

32765 PRESSURE-INDUCED SUPERCONDUCTIVITY IN CESIUM AND YTTRIUM. Wittig, Joerg (Univ. of California, San Diego, La Jolla). Phys. Rev. Lett.; 24: 812-15(13 Apr 1970).

Superconductivity was observed in a high-pressure phase of cesium. Yttrium, normal at zero pressure down to millidegree temperatures, shows pressure-induced superconductivity above 110 kbar, apparently without change in crystal structure. Superconductivity, once restricted to the puzzling case of lanthanum in this part of the periodic system, turns out to be the general phenomenon when pressure is applied. (auth)

32766 BRILLOUIN SCATTERING MEASUREMENTS OF THE VELOCITY AND ATTENUATION OF HIGH FREQUENCY SOUND WAVES IN SUPERFLUID HELIUM. Peters, R. L. St.; Greytak, T. J.; Benedek, G. B. (Massachusetts Inst. of Tech., Cambridge). Opt. Commun. 1: 412-16(Apr 1970).

From the Brillouin spectrum of scattered laser light, the velocity and attenuation of thermally driven high-frequency first sound in liquid helium were measured under its saturated vapor pressure between 1.25°K and the lambda point. The sound wave vector was fixed at 2.0339×10^5 cm^{-1}; the frequency varied from 768 MHz at the lowest temperature to 709 MHz near T_λ. No dispersion in the sound velocity was found except quite near T_λ. The attenuation shows a sharp rise near T_λ and, for the lower temperatures, a definite peak whose maximum lies between 1.4 and 1.5°K. The results are compared with the theory of Landau and Khalatnikov near T_λ and with the theory of Khalatnikov and Chernikova at lower temperatures. (auth)

32767 NONLINEAR MICROWAVE PROPERTIES OF THIN SUPERCONDUCTING FILMS. Gubankov, V. N.; Likharev, K. K.; Margolin, N. M. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 11: 157-60(5 Mar 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 246-50(5 Mar 1970).

An attempt is made to show that nonlinear phenomena are connected with the structure produced in the films by vortices whose symmetry axes are normal to the plane of the film. A model of an experiment of the Clorfeine type with a rectangular dielectric resonator is considered. Only the oscillation modes that are noticeably coupled to the incident microwave are considered. The model was verified by special experiments on the behavior of rutile resonators whose larger faces were sputtered thin films of tin, in response to microwave signals in the frequency ranges 9 to 10 and 35 to 39 GHz. It follows from the model that the nonlinear effects in similar experiments are connected only with the motion of the vortices, and not with the manifestation of a nonlinearity of the Ginzburg–Landau type. (M.H.R.)

32768 CRITICAL POWER DISSIPATION IN A SUPERCONDUCTOR. Rabinowitz, Mario (Stanford Univ., Calif.). Appl. Phys. Lett.; 16: 419-21(1 Jun 1970).

The magnetic breakdown field H_p' is calculated which, if applied at the surface of a superconductor, produces a critical power dissipation leading to a steep rise in the power loss. Generally $H_p' < H_c$, the critical field of the material. The functional dependence of the Q of a microwave cavity for values of H_p near H_p' is also found. (auth)

32769 CURRENT DISTRIBUTION IN PARALLEL SUPERCONDUCTING WIRES. Oswald, D. (AEG-Telefunken-Forschungsinstitut, Frankfurt am Main). Z. Angew. Phys.; 29: 132-5(1970). (In German).

The current distribution in parallel superconducting wires de-

pends only on the magnetic coupling between the conductors. The current distribution in parallel superconducting wires arranged in a plane was studied in theory and experiment. The behavior of such an arrangement was also investigated when one or more conductors became resistive. Furthermore, the properties of a variety of parallel arrangements were discussed. (auth)

32770 HALL ANGLE OF A NORMAL CURRENT FLOWING THROUGH THE CORE OF A VORTEX. Cleary, Robert M. (Univ. of Illinois, Urbana). Phys. Rev., B; 1: 4686-92(15 Jun 1970).

A calculation, based on the microscopic theory of superconductivity, is made of the Hall angle of a normal current flowing through the core of a single vortex. The magnetic vector potential is assumed uniform throughout the core region and the moments of the current are taken with the electric field. The ratio of these two quantities yields the tangent of the Hall angle. In agreement with a prediction of Bardeen, $\tan\alpha = (e\tau/mc)H_{eff}$ is found, where τ is the relaxation time of the electrons, and the effective magnetic field H_{eff} is in part due to the depression in the order parameter at the core of the vortex and in part to the actual magnetic field in the core of the vortex. For niobium, H_{eff} is very nearly equal to H_{c2}. At 0°K for niobium, our theory is valid for l/ξ ranging from ∞ to about 10, where l is the mean free path and ξ the coherence length. (auth)

32771 SUPERCONDUCTIVITY IN $PbNbS_3$ AND $PbTaS_3$. Schmidt, L. (Univ. of California, San Diego, La Jolla). Phys. Lett.; 31A: 551-2(18 May 1970).

$PbNbS_3$ and $PbTaS_3$ are superconducting below 2.62 and 3.07°K, respectively. For the isomorphous compound $PbTiS_3$, no superconductivity was observed above 0.05°K. A general correlation between valence state and superconductivity in covalent compounds is deduced. (auth)

32772 FOURTH SOUND ATTENUATION BY A SUPERFLOW IN A POROUS MEDIUM. Francois, M.; Le Ray, M.; Bataille, J. (Faculte des Sciences, Orsay, France). Phys. Lett.; 31A: 563-4(18 May 1970).

It is shown experimentally that fourth sound attenuation by a superflow versus mean superfluid velocity exhibits quadratic dependence, followed by peculiar behavior such as: important decrease, abrupt increase, and strong hysteresis. (auth)

32773 HARMONIC GENERATION FROM A SUPERCONDUCTIVE THIN-FILM BRIDGE. Seraphim, G. R. S.; McDermott, R. C. (Oxford Univ.). Phys. Lett.; 32A: 35-6(1 Jun 1970).

A harmonic output at 8.670 GHz was detected from a superconductive thin-film bridge when irradiated with electromagnetic radiation at 4.335 GHz. This output was quenched by taking T above T_c or applying magnetic fields of 15 G. (auth)

32774 ELECTRON TUNNELING INTO DILUTE CuCr AND CuFe ALLOY FILMS. Dumoulin, L. (Faculte des Sciences, Orsay, France); Guyon, E.; Rochlin, G. I. Solid State Commun.; 8: 287-90(15 Feb 1970).

Tunneling experiments on dilute homogeneous magnetic alloys of Cu by means of Al/oxide/CuCr and Al/oxide/CuFe junctions have shown that there is no concentration dependent structure in the tunneling density of states to $<10^{-3}$ of the background conductance over a wide range of temperature, concentration and magnetic fields, in agreement with recent theoretical calculations. Some concentration independent structure was observed which appears to be due to the Cu itself, and is not presently understood. (auth)

32775 DETAILED MEASUREMENTS OF THE QUANTIZED FLUX STATES OF HOLLOW SUPERCONDUCTING CYLINDERS. Goodman, William L.; Deaver, Bascom S. Jr. (Univ. of Virginia, Charlottesville). Phys. Rev. Lett.; 24: 870-3(20 Apr 1970).

The magnetic flux trapped in superconducting tin cylinders (56-μm ID, 0.7- to 5-μm walls, 24 mm long) is measured and it is found that for most values of applied magnetic field the entire cylinder is in the same quantized flux state trapping an integral multiple of $hc/2e \pm 1\%$. For some applied fields there is evidence that the cylinder exists in a mixed state with bands along the length in states differing by one flux quantum. (auth)

32776 DOMAIN MODEL FOR FLUX TRAPPING IN SUPERCONDUCTING CYLINDERS. Pierce, John M. (Univ. of Virginia, Charlottesville). Phys. Rev. Lett.; 24: 874-6(20 Apr 1970).

A model is proposed consisting of domains with alternating circulation along the length to account for observations of flux trapped by superconducting cylinders in amounts intermediate between the flux quanta. The domains are shown to be metastable once they are established, and two mechanisms for nucleating domains are discussed. (auth)

32777 THERMAL FLUCTUATIONS IN SUPERCONDUCTING WEAK LINKS. Simmonds, M.; Parker, W. H. (Univ. of California, Irvine). Phys. Rev. Lett.; 24: 876-9(20 Apr 1970).

The current–voltage characteristics of superconducting weak links are measured near their transition temperature. The effect of thermal fluctuations on these characteristics is found to be in excellent agreement with a calculation of Ambegaokar and Halperin. (auth)

32778 FLUCTUATION EFFECTS IN THE ac CONDUCTIVITY OF THIN LEAD FILMS BELOW THE SUPERCONDUCTING TRANSITION TEMPERATURE. Lehoczky, S. L. (McDonnell Douglas Corp., St. Louis); Briscoe, C. V. Phys. Rev. Lett.; 24: 880-2(20 Apr 1970).

The transmission of microwaves through thin (≤150 Å) Pb films indicates considerable excess conductivity at temperatures below the superconducting transition temperature. This excess conductivity is interpreted as evidence for fluctuations in the order parameter below T_c. (auth)

32779 HYPERSONIC ATTENUATION IN SUPERCONDUCTING MOLYBDENUM. Pike, Gordon Enslow. Pittsburgh; Univ. of Pittsburgh (1969). 90p.

Thesis.

The absorption of high energy longitudinal phonons as a function of temperature in pure, single-crystal molybdenum has been measured in the [111] direction for temperatures between 0.37 and 1.2°K. The phonon frequency, 9.4 GHz, is at least 10 times that used in previous ultrasonic experiments on molybdenum. These phonons have an energy comparable to the superconducting energy gap, $2\Delta(T)$, and the relative energy, $h\nu/2\Delta(0) = 0.18$, is the largest yet used in ultrasonic studies of any superconductor. Since the energy gap smoothly decreases to zero at the superconducting transition temperature [$2\Delta(T_c) = 0$], there exists an appreciable temperature range in which the phonons are energetic enough to excite quasiparticles across the gap. This leads to an absorption edge when $h\nu = 2\Delta(T_d)$, where $T_d < T_c$. Using the Bardeen–Cooper–Schrieffer (BCS) theory of superconductivity a computer program has been written to generate theoretical attenuation curves for trial values of $2\Delta(0)$ and the normal state attenuation, $\alpha_N(0)$. Comparing these curves to the data, especially near the absorption edge, we find evidence for a multiple-gap model of molybdenum. Phonons propagating in the [111] direction interact with quasiparticles which appear to have gaps of $2\Delta_1(0) = 2.7\ kT_c$ and $2\Delta_2(0) = 3.1\ kT_c$. The normal state attenuation for these phonons is 500 db/cm. Combining the results with those obtained by others at lower frequencies the anisotropy of normal state attenuation and gap values is analyzed on the basis of molybdenum's Fermi surface. Normal state attenuation anisotropy is satisfactorily explained from the Fermi surface topology. Gap anisotropy is discussed using a model which assigns a different gap value to each sheet of the Fermi surface. (Disser. Abstr. Int., B)

32780 MICROWAVE STUDIES OF THIN SUPERCONDUCTING TIN FILMS. Soderman, Donald Arvid. Troy, N. Y.; Rensselaer Polytechnic Inst. (1969). 193p.

Thesis.

Microwave transmission measurements at 9.4 GHz have been made through thin superconducting tin films as a function of temperature, perpendicular magnetic field, microwave power level, and dc bias current. At low power levels the complex conductivity is in rough agreement with that predicted by the Mattis and Bardeen formulation of a weak-coupling BCS superconductor. However, the imaginary component of the conductivity is consistently smaller than that predicted. A reduced average energy gap and strong-coupling interpretations are proposed. The perpendicular magnetic field dependence of the microwave impedance is in better agreement with that calculated from a nonlocal spatial variation in the energy gap than that expected for fluxon flow phenomena. The Type II behavior of these superconducting films is confirmed by several low-frequency flux-penetration experiments. Transmission measurements made in the presence of a pulsed dc current and high power microwave fields allow a clear separation of regions where superelectron depairing and "domain growth" dominate. Low-power transmission measurements in the presence of a perpendicular magnetic field suggest that "domain growth" is the result of fluxon penetration. (Disser. Abstr. Int., B)

32781 SIZE EFFECTS IN LIQUID HELIUM II AS MEASURED BY FOURTH SOUND AND THE ATTENUATION OF FOURTH SOUND. Kriss, Michael Allen. Los Angeles; Univ. of California (1969). 121p.

Thesis.

Previous fourth sound (pressure-density waves in the superfluid component of He II) measurements in tightly packed powders revealed a systematic lowering of the superfluid density and superfluid onset temperature, T_0, below their bulk values. It was found that the lower T_0, the lower the value of the superfluid density at all temperatures. The resulting superfluid density versus temperature curves was found to form a family of curves whose characteristic parameter is T_0. A systematic study of fourth sound measurements in resonators packed with fine powders ranging in diameter from 90 Å to 5μ and under packing pressures up to 45,000 psi is presented. Superfluid onset temperatures from T_λ to 1.79°K are observed. The lowering of the superfluid density and superfluid onset temperature is found to be in good agreement with theoretical predictions based on size effects in He II, when pore size distributions of the packed powders are taken into consideration. Information on the pore size distributions is obtained from adsorption and desorption isotherms on the packed powders. The pore size distributions and measured values of T_0 indicate the presence of a strong interaction between adjacent pores near T_0. Additional verification of an empirical acoustical index of refraction, n, due to multiple scattering in the packed powders is presented. The empirical value $n = (2-P)^{\frac{1}{2}}$, where P is the porosity of the packed powder, is compared to theoretical results and is found to be in disagreement with them. The attenuation of fourth sound, as reflected in the quality factor, Q, of the resonances, is measured. The experiment results are compared with theoretical values of Q based on the imperfect locking of the normal fluid in the packed powders. The results show good agreement with theory for temperatures above 1.6°K, but the measured values of the Q fall below theoretical values below 1.6°K. Measurements of the superfluid density near T_λ in a resonator free of size effects show $\rho_s/\rho \sim (T_\lambda - T)^{\frac{1}{2}}$ which is in excellent agreement with previous measurements and results based on the scaling laws. (Disser. Abstr. Int., B)

32782 ROTATING SUPERCONDUCTORS AND RELATED EFFECTS. Brickman, Norman Frederick. New Haven; Yale Univ. (1969). 122p.

Thesis.

An apparatus was constructed for use in a liquid helium cryostat for the measurement of small magnetic field changes occurring within a detection chamber. The main experiment conducted was to rotate solid and hollow superconducting cylinders and measure the uniform magnetic field, called the London moment, that is generated in these cylinders due to their rotation. The agreement with theory for all the samples tested was found on an average to be within ±3% provided that the effective mass and charge for the superconducting particles was taken as twice the free electron values. Measurements have also been made on the temperature dependence of magnetic flux trapped in stationary hollow thin-wall superconducting aluminum cylinders near their critical temperature, confirming the theory for the effect as well as showing that the electron mean free path in the cylinder wall is approximately equal to the thickness of the film. Measurements and results have also been presented concerning observations with the thin-wall cylinders showing an ac paramagnetic susceptibility peak at temperatures a couple hundredths of a degree above their critical temperature. (Disser. Abstr. Int., B)

32783 ANISOTROPIC SUPERFLUIDITY IN NEUTRON STAR MATTER. Hoffberg, M. (Vassar Coll., Poughkeepsie, N. Y.); Glassgold, A. E.; Richardson, R. W.; Ruderman, M. Phys. Rev. Lett.; 24: 775-7(6 Apr 1970).

The magnitude of the expected superfluid transition temperature and the form of the gap are obtained for regimes of neutron density expected in neutron-star cores. For neutron densities exceeding 1.5×10^{14} g cm^{-3} the gap is anisotropic but nodeless, leading to thermodynamic properties of a conventional BCS-type superfluid. (auth)

32784 LIQUID HELIUM AND THE PROPERTIES OF A BOSE-EINSTEIN GAS. III. THE DENSITY DEPENDENCE OF HARD-CORE MODELS. Goble, D. F. (Dalhousie Univ., Halifax, Nova Scotia). Can. J. Phys.; 48: 1340-64(1 Jun 1970).

The results of a previous paper by Goble and Trainor were used to compute the density dependence of the hard-core Bose-Einstein gas in the t-matrix ladder approximation, utilizing the coordinate-space method of Brueckner and Sawada as modified by Parry and ter Haar, and the pseudopotential treatment of the hard-core boundary condition presented by Liu and Wong. Various thermodynamic parameters of these model systems are compared with the properties of liquid helium-4. The disagreements which are found are shown to be primarily related to differences in the magnitudes of the Landau parameters. (auth)

32785 DAMPING OF A HEATED OSCILLATING CYLINDER IN He II. Payne, R. S. (Yale Univ., New Haven). Phys. Rev. Lett.; 24: 710-12(30 Mar 1970).

The charge in the logarithmic decrement upon applying heat to a freely oscillating cylinder in He II was measured. After corrections, caused by heat, in the normal viscous contribution to the decrement the results are used to verify the prediction by Penney and Overhauser that a torque should exist on a uniformly heated cylinder about which there is a superfluid circulation. A critical comparison is made between the results of the present experiment and the prior work of Hunt who employed a quite different method. (auth)

32786 THERMODYNAMICS NEAR THE TWO-FLUID CRITICAL MIXING POINT IN ^{3}He–^{4}He. Griffiths, Robert B. (Carnegie-Mellon Univ., Pittsburgh). Phys. Rev. Lett.; 24: 715-17(30 Mar 1970).

The two-fluid critical mixing point in ^{3}He–^{4}He differs from ordinary critical points in that it occurs at the intersection of three lines of critical points, in a suitable variable space. A free-energy function is proposed that removes certain discrepancies between classical (Landau) theory and experimental thermodynamic measurements. Certain solid-state transitions (e.g., the metamagnetic–antiferromagnetic transition in $FeCl_2$) are thermodynamic analogs of critical mixing in ^{3}He–^{4}He. (auth)

32787 ac-JOSEPHSON-EFFECT DETERMINATION OF e/h WITH SUB-PART-PER-MILLION ACCURACY. Finnegan, T. F.; Denenstein, A.; Langenberg, D. N. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett.; 24: 738-42(30 Mar 1970).

An ac-Josephson-effect determination of e/h was made using a new method. The accuracy of the result referred to the local voltage standard is 0.13 ppM. The accuracy referred to the National Bureau of Standards as-maintained volt is 0.46 ppM. The final value is $2e/h = 483.593\ 65 \pm 0.000\ 22\ \text{MHz}/\mu V_{68\,\text{NBS}}$ (0.46 ppM). (auth)

32788 CRITICAL VELOCITIES OF PERSISTENT CURRENTS OF SUPERFLUID HELIUM. Weaver, James Cowles. New Haven; Yale Univ. (1969). 139p.

Thesis.

The angular momentum of persistent currents of superfluid helium in several annular shaped buckets was measured as a function of the angular velocity at which the current was created. For the annular widths used it is a reasonable approximation to regard the current velocity as a constant, and for the first time the maximum linear velocities of persistent currents have been measured. These maximum velocities are the superfluid critical velocities for the annular channels used. The channels are of annular width $d = R_2 - R_1$ and height D, with $d/D \geq 3$ for all buckets but one. A simple model is discussed for a critical velocity, v_c, which is due to pinned vortex lines and which is a function of D. Also, attention is drawn to Fetter's formula for Ω_{c1}, the critical angular velocity for the appearance of vortex lines in a narrow annulus [$(\alpha \ll R_2 - (d/2) = R)$]. Ω_{c1} is a function of d. The experimental values of the critical velocities obtained here suggest that two qualitatively different types of persistent flow occur, provided that Fetter's Ω_{c1} is identified with the superfluid rather than the bucket: 1) if $v_c > R\Omega_{c1}$ the maximum velocity of a current is v_c and the current contains pinned vortex lines, and 2) if $v_c < R\Omega_{c1}$ the maximum velocity is $R\Omega_{c1}$ and the current is irrotational. Case 1) is used to present a new explanation of the null result of Andreikashvili's original attempt to observe persistent currents. Finally, the recent criticism of Van Alphen et al., which claims that all previous experiments measuring vortex critical velocities are incorrect is considered. This criticism claims that previous experiments really measured the onset of normal fluid turbulence. However, a worst-case calculation is presented which shows that normal fluid turbulence is absent in the present experiment, so that the overall results of this investigation lend strong support to vortex lines as a mechanism for superfluid critical velocities. (Diss. Abstr. Int., B)

32789 OSCILLATIONS AND DISSIPATION IN THE FLOW OF HELIUM FILM. Hammel, E. F.; Keller, W. E.; Sherman, R. H. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett.; 24: 712-15(30 Mar 1970).

The damping and frequency of oscillations in liquid level between two open reservoirs of helium II connected by film were observed to change with time following level equilibration. A maximum in the damping was found to coincide with a maximum in ν. The change in frequency is interpreted as a change in the thickness of the film, a change in ρ_s, or both. (auth)

32790 MEASUREMENT OF TEMPERATURE AND MAGNETIC FIELD DEPENDENCE OF PENETRATION DEPTH IN SUPERCONDUCTING ALUMINUM. Behroozi-Toosi, Fereidoon. Pittsburgh; Univ. of Pittsburgh (1969). 67p.

Thesis.

The dependence of the superconducting penetration depth λ on temperature and magnetic field in pure and doped single crystals of aluminum was studied at a frequency of about 1 kHz. Using a method similar to that employed by Schawlow and Devlin, and utilizing a very stable oscillator, changes in λ were measured to within 0.5 Å. The findings on the temperature dependence of λ disagree in details with measurements of McLean on aluminum at 175 MHz, but are in substantial agreement with BCS theory and are of the form reported by Schawlow and Devlin on tin. About 15% anisotropy in λ is observed in pure aluminum similar to that reported by Faber and Pippard. As for the field dependence of λ in pure aluminum, the results are in excellent agreement with the predictions of Garfunkel, whose model associates the effect of a magnetic field with a change in the kinetic energy of quasiparticles in the Meissner current. The maximum field effect occurs at $t = T/T_c = 0.55$ for fields up to $h = H/H_c = 0.7$. In the doped sample (99.8% Al and 0.2% Ag), λ is found increasing quadratically with field near T_c as predicted by Ginzburg–Landau theory. In particular, the measured value of the Ginzburg–Landau parameter $\bar{\alpha}$ for the doped sample is in good agreement with the theoretical value. (Diss. Abstr. Int., B)

32791 SUPERCONDUCTIVITY OF THE TUNGSTEN BRONZES. Sweedler, Alan Robert. San Diego, Calif.; Univ. of California (1969). 130p.

Thesis.

Superconductivity is found to occur in the tungsten bronzes that are nonstoichiometric compounds of the type M_xWO_3, $(0 < x < 1)$, where M is usually an alkali metal or alkaline earth. Depending on the value of x, the bronzes crystallize in three crystal structures: cubic (perovskite), tetragonal, and hexagonal. Superconductivity occurs in the tetragonal and the hexagonal structures, but does not occur in the perovskite structure. The bronzes found to be superconducting are: hexagonal K_xWO_3(0.50°K, $x \sim 0.27$), Rb_xWO_3(2.01°K, $x \sim 0.27$), Cs_xWO_3(1.10°K, $x \sim 0.33$), and tetragonal Na_xWO_3(0.56°K, $x \sim 0.35$), K_xWO_3(1.50°K, $x \sim 0.57$), Ba_xWO_3 (2.18°K, $x \sim 0.13$). The bronzes found nonsuperconducting to 0.35°K are cubic H_xWO($x \sim 0.5$), Li_xWO_3($x \sim 0.50$), Na_xWO_3(x = 0.40 to x = 0.80) and distorted cubic Li_xWO_3($x \sim 0.1$), H_xWO_3($x \sim 0.23$), Na_xWO_3($x \sim 0.1$). The superconducting transition temperature, T_c, of hexagonal Rb_xWO_3($x \sim 0.3$) increases approximately by a factor of three when the bronze is treated in sulfuric acid or treated with pure WO_3 in vacuum. Both these treatments remove Rb from the lattice, resulting in a shortening of the hexagonal axis without a change in the crystal structure. Annealing acid-treated samples of Rb_xWO_3 in vacuum results in a lowering of T_c to approximately its pretreated value. Also, cold working acid-treated samples results in an 80% reduction of the amount of material superconducting. The occurrence of superconductivity in bronze systems is discussed in terms of a lattice instability in the nonsuperconducting perovskite phase of Na_xWO_3. The results for the superconducting behavior of Rb_xWO_3 are discussed in terms of the crystal structure of this compound. (Diss. Abstr. Int., B)

32792 HIGH PRESSURE PERFORMANCE OF AN Nb_3Sn RIBBON SOLENOID. Fast, R. W. (Univ. of Wisconsin, Stoughton). Rev. Sci. Instrum.; 41: 884-5(Jun 1970).

The behavior of a superconducting Nb_3Sn ribbon solenoid at elevated temperatures and pressures was studied. A graph of quench current vs. temperature at atmospheric pressure and at elevated pressure (up to 22.8 atmospheres) is included. (W.H.K.)

32793 THERMAL CONDUCTIVITY OF A ^3He–^4He MIXTURE NEAR THE SUPERFLUID TRANSITION. Ahlers, Guenter (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Lett.; 24: 1333-6(15 Jun 1970).

Measurements are presented which show that the thermal conductivity κ in a ^3He–^4He mixture is finite but singular at the superfluid transition temperature T_λ. From this, it can be concluded that dynamic scaling predicts a divergent mass-diffusion coefficient for the normal phase. Through a semiempirical approach, κ for the mixture is shown to be consistent with the divergent κ for pure ^4He. (auth)

32794 MICROSCOPIC DERIVATION OF TRANSPORT EQUATIONS FOR REAL SUPERFLUID SYSTEMS. Winter, Hermann (Max Planck-Institut fuer Physik und Astrophysik, Munich). Z. Phys.; 235: 369-82(1970).

Equations for correlation functions of real superfluid helium are derived microscopically. A division into the contribution of the normal component and the condensate is made. Then it turns out that the distribution function of the normal component obeys a phonon Boltzmann equation. The scattering term for three-phonon processes is calculated. It is established that the phonons interact via deformation potentials. The coupling constants are Grüneisen parameters. In addition, the effective coupling of the phonons to external fields is derived. (auth)

32795 THERMODYNAMIC PROPERTIES AND SUPERCONDUCTIVITY OF OHMIC MATERIALS. Wolf, Alfred A. (Naval Ship Research and Development Lab., Annapolis, Md.). J. Franklin Inst.; 289: 193-204(Mar 1970).

It is established from the first and second laws of thermodynamics that Ohm's law is thermodynamically valid only under an isothermal process, a result known empirically since the discovery of this law. Furthermore, in an Ohmic material, the ratio of the Helmholtz free energy of the material to the total energy density (total energy per unit Ohm) is a constant and this constant turns out to be the resistance of the material. It is also shown that if an Ohmic material becomes a superconductor then its transition temperature is directly proportional to its net internal energy and inversely proportional to its entropy. This implies that for superconducting Ohmic materials, in which the internal energy is high and the entropy is low, the transition temperature will be high. Although this relationship between transition temperature, internal energy, and entropy does not predict the transition temperature, it does give an appreciation for the factors involved and therefore one can conjecture that high-temperature superconductors are possible. Furthermore, if the ordering of the material is improved, the transition temperature increases. This ordering is equivalent to the entropy being lowered in the material. (auth)

32796 MODEL OF THE ANISOTROPIC ENERGY GAP IN SUPERCONDUCTING ZINC. Hays, D. A. (Univ. of Pittsburgh). Phys. Rev., B; 1: 3631-6(1 May 1970).

A simple model for the anisotropic energy gap in superconducting zinc is shown to be sufficient in describing microwave-absorption measurements. The value assigned to the energy gap near the c axis is uncertain because of the possibility of photon absorption occurring simultaneously with a diffuse scattering of quasi particles at the surface. (auth)

32797 SUPERCONDUCTING ALLOYS OF VARIABLE COMPOSITION. Savitskii, E. M.; Baron, V. V.; Gindina, S. D. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 191: 338-40 (11 Mar 1970). (In Russian).

An attempt was made to determine the superconducting T_c of all compositions within a system on a single but variable-composition specimen. The niobium–tantalum solid solution system was used for the measurements, as in this system T_c is an additive function of the composition. The specimen, prepared by electron-beam zone melting, had a composition ranging from 100% tantalum at one end, to 20% tantalum and 80% niobium at the other one. The electrical resistance of this specimen was measured at room and liquid-nitrogen temperatures, determining also the temperature of transition into superconducting state. The specific resistivity maxima at 77 and 300°K at 28% or about 40 at. % niobium were found to be typical for binary solid solutions; they are attributed to lattice distortion and complication in the interatomic bond because of the introduction of the second component. The results agree with reported data obtained with separate specimens of uniform composition. (TTT)

32798 MATRIX METHOD FOR CALCULATING THE SPECTRAL AND ANGULAR CHARACTERISTICS OF γ-RADIATION EMERGING FROM A SLAB SHIELD. Churin, S. A.; Chernyakhovskii, V. V. This paper was summarized in At. Energ. (USSR); 26: 59-60(Jan 1969) as paper No. 260. (In Russian).

The spectral and angular characteristics of γ radiation emerging from a slab shield are computed by a matrix method. It is supposed that between two elementary layers there is a radiation source $I(Z,E,\theta)$ where Z is the distance along the Z axis perpendicular to the plane of the slab, E the energy of a γ photon, and θ the angle between the direction of propagation of the γ radiation and the Z axis. In this case, the spectral and angular distributions of the emerging γ radiation may be found by using the reflection and transmission matrices of the elementary layers: $I = T_2 (E - R_1R_2)^{-1} (E + R_1) I_0$, where I_0 is the radiation source vector, I the emerging radiation vector, R_1 the reflection matrix for the first layer, T_2 and R_2 the transmission and reflection matrices for the second layer, and E the unit matrix. If the slab shield is imagined to consist of a set of elementary layers with bounding planes Z_k where k varies from 1 to n-1, the transmission and reflection matrices may be obtained by using the expressions for the R and T matrices for a slab consisting of two elementary layers: $T = T_2 (E - R_1R_2)^{-1} T_1$; $R = R_1 + T_1R_2 (E - R_1R_2)^{-1} T_1$. Using the method just described the results were obtained for the number of emerging γ photons as a function of the position of an 8-MeV source; each energy group was normalized to 1 MeV, and it was assumed that there was one photon in each plane. (auth)

32799 ULTRASONIC ATTENUATION IN CURRENT-CARRYING SUPERCONDUCTORS CONTAINING PARAMAGNETIC

IMPURITIES. Kolpagiu, M. K.; Kon, L. Z. (Inst. of Applied Physics, Kishinev). Phys. Status Solidi; 39: 61-5(1 May 1970).

Ultrasonic attenuation in superconductors carrying persistent currents in the presence of paramagnetic impurity scattering was investigated. The limiting case of high-impurity concentrations is considered. General expressions for the attenuation coefficients are obtained in the case of space-independent sound waves. The attenuation coefficients at relatively low frequencies and low temperatures are evaluated explicitly. Gapless superconductors are also considered. (auth)

32800 MICROWAVE-ABSORPTION DETERMINATION OF THE ANISOTROPIC ENERGY GAP IN SUPERCONDUCTING ZINC. Evans, J. B.; Garfunkel, M. P.; Hays, D. A. (Univ. of Pittsburgh). Phys. Rev., B; 1: 3629-30(1 May 1970).

The anisotropic superconducting energy gap of pure zinc was determined from microwave-absorption measurements for photon energies between 1.0 and 5.5kT_c where T_c = 0.837°K. The minimum and dominant energy gap corresponds to $(3.1 \pm 0.1)kT_c$ at T = 0. A much larger energy gap is observed for directions near the c axis. (auth)

32801 SUPERCONDUCTING TUNNELING IN SINGLE-CRYSTAL AND POLYCRYSTAL FILMS OF ALUMINUM. Wells, G. L.; Jackson, J. E.; Mitchell, E. N. (Univ. of North Carolina, Chapel Hill). Phys. Rev., B; 1: 3636-44(1 May 1970).

The energy gap (2Δ) and transition temperature (T_c) of aluminum films in Al/insulator/M tunnel junctions was measured. The orientation and crystallite size of the aluminum film was changed for different tunnel junctions by changing the substrate and/or substrate temperature at evaporation. The second metal (M) was either aluminum or indium. It was found that the strain on the aluminum film due to differential thermal expansion could account for most of the observed variation in T_c. If M were indium, both 2Δ and T_c were changed. Empirically, it was found that T_c was increased by 3.2% and 2Δ was decreased by 3.3% owing to the indium film. This effect is not understood. The energy gaps of the aluminum films were 3.64kT_c for tunneling in the [100] direction, 3.52kT_c for tunneling in "isotropic" material, and 3.41kT_c for tunneling in the [111] direction. This anisotropy is in approximate agreement with theoretical predictions. (auth)

32802 EFFECT OF JUNCTION GEOMETRY ON MAXIMUM ZERO-VOLTAGE JOSEPHSON CURRENT. Johnson, W. J.; Barone, A. (CNR, Naples). J. Appl. Phys.; 41: 2958-60(Jun 1970).

Tin/tin oxide/tin Josephson junctions were fabricated by glow discharge oxidation of films evaporated in the 10^{-7} to 10^{-8}-torr range. Saturation of the maximum zero-voltage current with increasing junction length was observed for a crossed-film geometry, and a linear increase of maximum zero-voltage current with junction length was observed for an overlap geometry. Approximate agreement with the theory of Owen and Scalapino was obtained. (auth)

32803 MAGNETO-OPTICAL OBSERVATION OF THE MAGNETIC FLUX STRUCTURE IN SUPERCONDUCTING NIOBIUM. Huebener, R. P.; Rowe, V. A.; Kampwirth, R. T. (Argonne National Lab., Ill.). J. Appl. Phys.; 41: 2963-7(Jun 1970).

The magnetic flux structure in superconducting niobium was studied using the high specific Faraday rotation in thin films of a mixture of EuS and EuF_2 at low temperatures. The magneto-optical detection system had a resolution of about 20 μm. The specimens were niobium foils 18-μm thick and vacuum-deposited niobium films. In the foils, after raising the magnetic field and returning it to zero, the trapped flux structure consists of large domains of flux with opposite direction in the specimen. The arrangement of the domains is closely related to the sample shape. As in a ferromagnetic body, the domains are established to reduce the total free energy of the system. The Nb films show a very inhomogeneous magnetic flux distribution consisting of regions with very large local magnetic fields. (auth)

32804 HIGH-FIELD CHARACTERISTICS OF SUPERCONDUCTING WIRES MEASURED IN A PULSED MAGNET. Inoue, Kiyoshi; Tachikawa, Kyoji (National Research Inst. for Metals, Tokyo). J. Jap. Inst. Metals; 34: 202-9(Feb 1970). (In Japanese).

High-field characteristics of several kinds of superconducting wires were studied by a pulsed magnet. An electrical energy of 28.3 kJ, stored in a capacitor bank, was transferred to the liquid-nitrogen-cooled magnet. The ID of the magnet was 30 mm and the maximum field produced was 220 kOe with a rise time of 16 msec. The noise due to the induced voltage was canceled by a compensation coil. The transition sensitivity of the measuring system was 0.1 mV. Resistive critical fields H_r measured by the pulsed magnet with rise times longer than 10 msec were quite consistent with those measured by a steady-field magnet. Critical current densities J_c of Nb−Zr alloy wires were much decreased by the pulsed fields, whereas in compounds wires, e.g., V_3Ga and Nb_3Sn, the decreases of J_c were small. Resistivity changes in flux flow states and the peak effect phenomena could also be observed by the pulsed field measurement. The H_r of Nb−Zr alloy wires were increased by the decomposition reaction at 785°C and decreased by the eutectoid reaction at 560°C. V_3Ga wires made by a new solid-state diffusion process at 600 to 700°C showed higher J_c than those of Nb_3Sn above 120 kOe. H_r of V_3Ga wires seemed to be around 220 kOe at 4.2°K. (auth)

Plasma and Thermonuclear Physics

32805 (TID-3557(1969 Suppl.)) CONTROLLED FUSION AND PLASMA RESEARCH. A Literature Search. Whitson, Milton O. (comp.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Jan 1970. 493p. Dep. CFSTI.

This search includes 2849 references on various aspects of plasma physics and controlled thermonuclear research. Report number, author, corporate author, and subject indexes are included. (auth)

32806 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. VOLUME 4, NO. 4, 1970. Bibliography, Author Index, Subject Index, Appendix. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1970). 40p.

Citations to 203 articles are included. (M.O.W.)

32807 PLASMA PHYSICS INDEX. VOLUME 5, NO. 4, 1970. Bibliography, Author Index, Subject Index. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1970). 123p.

This listing includes 589 articles on various aspects of plasma physics. (M.O.W.)

Confinement and Heating

32808 (NP-18257) ONE OF THE RULES FOR PLASMA DIFFUSION IN STELLARATORS. Shpigel', I. S. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1970. 15p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Plasma confinement in stellarators was analyzed within the concepts of plasma diffusion in toroidal systems. Calculations of various cases of plasma diffusion confirmed the experimental data on linear dependence of normalization of plasma confinement time τ/τ_B on the magnitude of the angle of transformation of the magnetic field lines. The theory of the diffusion of weak collisional plasma in toroidal axially asymmetric stellarator systems is still very new and was used in this work only for determining the diffusion coefficients as functions of the characteristics of confining field and plasma parameters. (R.V.J.)

32809 (UCRL-50824) PLASMA HEATING IN THE SUPERCONDUCTING LEVITRON BY ENERGETIC ELECTRONS. Anderson, O. A.; Hartman, C. W. (California Univ., Livermore. Lawrence Radiation Lab.). 1 Apr 1970. 10p. Dep. CFSTI.

Experiments with axisymmetric toroidal devices such as Levitrons or Tokamaks have yielded dense plasmas with confinement times exceeding Bohm time by two orders of magnitude. Furthermore, nearly classical energy confinement has been demonstrated in Tokamaks. If this situation is maintained at higher temperatures, then self-sustaining thermonuclear reactions seem feasible. Thus, a convenient method for heating dense plasma to the ignition temperature is needed. It is shown in the present paper that in an axisymmetric torus, energetic electrons, heated in situ by microwaves before introduction of the dense plasma, can provide such heating. Assuming classical energy confinement, it is found that ignition temperature can be reached in a device of moderate size and field strength, comparable with the existing superconducting Levitron. Plasma density is not limited by microwave cutoff. The ring current required depends on the field shape needed to confine the energetic electrons, but may be as low as 500 kA. (auth)

32810 DIFFERENCE FREQUENCY HARMONIC ION HEATING USING WHISTLER MODES. Capjack, C. E.; James, C. R. (Univ. of Alberta, Edmonton). Can. J. Phys.; 48: 1386-1409(1 Jun 1970).

The heating of ions in a magnetized plasma by the second-order electric fields generated through the nonlinear mixing of two whistler modes is examined. The kinetic equations describing the mixing and heating process are solved using the method of orbit integrations. Two techniques are available for optimizing the en-

ergy absorbed by the ions. One is to allow the mixed wave to approach a natural mode in the plasma, resulting in a field resonance. A second method is to have the ions absorb energy through cyclotron damping. The latter technique and the combination of the two optimizing schemes are investigated. The resulting sensitivities to fluctuations in frequency, density, static magnetic field, and the direction of propagation of the source waves are given. (auth)

32811 NONLINEAR PLASMA HEATING IN A MICROWAVE DISCHARGE. Rode, Daniel Leon. Cleveland; Case Western Reserve Univ. (1968). 138p.

Thesis.

Intense ionization in a plasma is produced by a microwave discharge. The coupling of the microwave energy to the plasma is improved by the use of a concentric spherical resonator, the plasma being the inner sphere. The eigenfrequencies for the resonator are tabulated and compared with the experiment. For a 1.0-MW pulse of 1.5 μ sec duration, electron densities of 2×10^{13} cm^{-3} and electron temperatures of 6 eV are obtained. For densities greater than cutoff ($10^{\prime\prime}$ cm^{-3} at 3.1 GHz), the incident electromagnetic wave is observed to be dissipated in a sheath ~1.4-cm thick because of the skin effect. Despite the absence of intense fields at the center of the plasma, it is found that the density rises to two-hundred times beyond cutoff. A numerical treatment of a nonlinear description for electron heating in the electric field sheath is obtained. The analyses predict that, for the conditions existing in the experiment, electron heating should occur. Electron density and temperature are measured by an infrared laser interferometer and an electrostatic double probe. A novel method for determining the frequency response of the 3.39-μ He–Ne laser indicates an exponential risetime of 11 nsec for the interferometer. The double probe is operated in a time-sampled mode that yields current–voltage characteristics in a sampling time of 150 nsec. Both diagnostic techniques apply to transient, one-shot, or repetitively pulsed experiments. (Disser. Abstr. Int., B)

32812 PARTICLE-LOSS MECHANISMS IN A TOROIDAL OCTUPOLE. Schmidt, John Allen. Madison, Wis.; Univ. of Wisconsin (1969). 209p.

Thesis.

Loss of plasma was observed across the flux shells in the toroidal octupole. Mechanisms that could be responsible for this particle loss are analyzed in detail. The Langmuir probe was the primary tool used to measure plasma properties. A new coupling to detect the floating potential of the plasma, exhibiting high input impedance, broad bandwidth, and small size was used. Energy considerations are used to show that simple interchange of flux tubes will not explain the observed losses. The effect of flux diffusion into the conducting boundaries is examined, and the loss rate due to this diffusion is limited to 10% of the observed loss at both the rods and the wall. The inductive electric fields, due to time varying magnetic flux, were found to be important only late in the experimental period. An experimental and theoretical analysis was made of the effects of introducing obstacles such as probes and rod supports into the plasma containment region. Convective cells were predicted and observed around these obstacles, which moved plasma both toward and away from the separatrix with no net loss required. These convective cells, along with the loss of particles on the obstacles, produce a density step across the obstacles in the azimuthal direction that is a function of obstacle bias. A theoretical analysis of flute waves in the octupole was carried out, predicting the interchange instability. Fluctuations satisfying the conditions for this instability are observed. Fluctuations generated by obstacles are also discussed. The obstacle-induced fluctuations inside the separatrix have one wavelength around the closed field lines, while those outside the separatrix are in phase at all points on a field line. The diffusion coefficients, estimated for various regions in the octupole, fell far below the level required to explain the observed loss in all regions except near the unstable region adjacent to the wall. The loss rates due to the particle-loss mechanisms that were examined were determined to be insufficient to explain the observed loss of plasma from the toroidal octupole. The results point the way to experiments that determine the extent and effect of azimuthal asymmetries in the plasma and finite gyroradii near the rods. (Disser. Abstr. Int., B)

32813 STOCHASTIC HEATING OF PLASMA PARTICLES. Makhan'kov, V. G.; Tsytovich, V. N. This paper was summarized in At. Energ. (USSR); 27: 53–4(Jul 1969) as paper No. 321/5046. (In Russian).

In considering the role of correlation effects in heating, it should be clearly stated that the stochastic field is considered as a steady-state field, so that $\langle E_{k\omega} E_{k'\omega} \rangle = V_{k\omega}\, \delta(k + k')\delta(\omega + \omega')$. The unambiguous relationship between ω and k that holds in the linear theory $[V_{k\omega} = V_k \delta(\omega - \omega_k)]$ does not apply to turbulent plasma. The transformation of the δ function into a finite-width function describes the correlation effects. The present article is not concerned with the process rendering a field stochastic, which constitute essentially unsteady phenomena, so that $\langle E_{k\omega} E_{k'\omega} \rangle$ depends not only on ω, but also on ω'. For greater clarity, magnetized plasma ($H \to \infty$) is contemplated. (auth)

Diagnostics

Refer also to abstracts 32615 and 32871.

32814 (ORNL–4425) REPORT OF INTEREM DATA SYSTEM. Francis, J. E.; Lazar, N. H. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 51p. Dep. CFSTI.

The INTEREM facility is currently being used to study plasmas consisting of a dense energetic electron distribution produced by electron-cyclotron resonant heating in a combination mirror-quadrupole confining magnetic field. Several diagnostic tools are used in this study. Among them are 1) the study of the bremsstrahlung spectrum resulting from electron–atom and electron–ion scattering, 2) the diamagnetic flux change resulting from turning the plasma on and off, and 3) the ionization current produced by the energetic electrons remaining during the plasma afterglow. A LINC-8 computer has been adapted to serve as a data acquisition system to assist in on-line analyses of bremsstrahlung spectra and to record machine parameters such as ambient pressure, magnetic field conditions, and applied heating power. The computer will also eventually be used to analyze the analogue data from the other two diagnostic sources, and the resulting system should provide a continuous monitor of electron distribution, density, and stored energy as a function of machine parameter variations. A discussion of the bremsstrahlung calculation and the program listing is given. (auth)

32815 IMPROVEMENT OF MAGNETIC PROBE MEASUREMENTS. Curzon, F. L.; Pachner, J. Jr.; Tam, Y. K. S. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 48: 1370–7 (1 Jun 1970).

By considering the current flow around a probe guide of a circular cross section, it is shown that the perturbed magnetic field can be partially "corrected" with a three-coil probe. The theory was tested in a coaxial cylindrical geometry, an analogue of a z-pinch discharge. The spatial resolution l of the three-coil probe is roughly one-half of the probe guide radius, a. For current distributions which vary slowly with distance (scale length, λ) it is shown that the fractional error in the magnetic field is $\sim 0.2(l/\lambda)^2$. For a single-coil probe the error is at least four times as large. (auth)

32816 MICROWAVE MEASUREMENT OF THE ELECTRON DENSITY PROFILE IN A SUPERSONIC ARC JET. Carlile, R. N. (Univ. of Arizona, Tucson); Baker, F. A.; Somes, A. H. Rev. Sci. Instrum.; 41: 815–18(Jun 1970).

A microwave probe is described that allows the electron density profile in a supersonic constricted arc jet plasma to be measured. Peak electron densities of $6 \times 10^{13}/cm^3$ were measured near the edge of the jet stream, with the electron density decreasing toward the center. (auth)

32817 MICROWAVE PLASMA DIAGNOSTICS. Shankowski, Allison Eugene. Vancouver, B. C.; Univ. of British Columbia (1969).

Thesis.

The development of accurate microwave methods for determining electron-density distributions in transient plasma columns was studied. Two new methods were developed and these were evaluated by comparing with other methods. The first is a microwave refraction technique which depends on multiple reflections of an obliquely incident microwave beam between the plasma critical layer and the walls of the discharge tube. The second method depends on reflection measurements at normal incidence, and is suitable for plasmas in which the maximum plasma frequency is greater than the applied frequency. This method is based on measuring the rate of change in phase of the reflected signal due to Doppler shift in frequency produced by motion of the plasma critical layer. (Disser. Abstr. Int., B)

32818 INFLUENCE OF METASTABLE ATOMS ON THE FLOATING POTENTIAL OF A LANGMUIR PROBE. Mewe, R. (FOM-Instituut voor Plasma-Fysica, Jutphaas, Netherlands). Physica; 46: 626–8(31 Mar 1970).

The quantitative effect of bombardment of a probe surface by metastable atoms on the floating-probe potential is discussed for the case of the positive column in a dc discharge in helium. (auth)

Kinetics (General)

32819 ELECTRON ENERGY DISTRIBUTION FUNCTION AT CYCLOTRON RESONANCE IN A BOUNDED MEDIUM. Un, Chong Kwan. Newark, Del.; Univ. of Delaware (1969). 114p.

Thesis.

The Boltzmann equation was solved for the energy distribution function of electrons of helium in a bounded medium. The energy distribution function is obtained with the following assumptions: (1) only electron motion is considered; (2) there exist a high-frequency electric field and an externally applied dc magnetic field with the directions perpendicular to one another; (3) the electron velocity distribution is nearly spherically symmetric at any point in the plasma cell; (4) that the elastic collision frequency of the electron is constant with energy. With the above assumptions the distribution function is solved separately in two regions, the elastic collision range and the inelastic collision range and, consequently, it is in the form of Kummer and Whittaker functions. The behavior of the distribution function in and near cyclotron resonance was closely examined. The electron energy distribution function is then used in predicting the energy needed for firing a helium plasma in the cell. The mechanism of energy coupling to electrons in and near cyclotron resonance was also explained. In addition, the polarization of the electric field in a circular waveguide was considered in conjunction with plasma firing. The theoretical prediction is close to the experimental data of the breakdown power measurement on a microwave bridge circuit. (Diss. Abstr. Int., B)

32820 MEASUREMENT OF $N_2^+ + e^-$ DISSOCIATIVE RECOMBINATION IN EXPANDING NITROGEN FLOWS. Dunn, Michael G.; Lordi, John A. (Cornell Aeronautical Lab., Buffalo, N. Y.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 339-45(Feb 1970).

The dissociative recombination rate coefficient for the reaction $N_2^+ + e^- \xrightarrow{k_r} N + N$ was measured in the inviscid nozzle flow of a short-duration reflected-shock tunnel and found to be given by $k_r = (1.5 \pm 0.5) \times 10^{22} T_e^{-1.5}$ cm^3/mole-sec for an electron temperature range of approximately 3500 to 7200°K. The test gas used in these experiments was nitrogen at equilibrium reservoir conditions of 6750°K and 13.1 atm pressure at 7200°K and 17.1 atm pressure. The electron density and the electron temperature were measured on the nozzle centerline at several axial locations using thin-wire Langmuir probes. The electron densities were simultaneously measured using microwave interferometers and found to be in good agreement with the probe data. (auth)

32821 CATHODE FALL AND NEGATIVE GLOW OF ANOMALOUS GLOW DISCHARGES IN A LONGITUDINAL MAGNETIC FIELD. I. A PHENOMENOLOGICAL THEORY. Franck, Guenter (Univ., Munich). Z. Phys.; 235: 313-26(1970). (In German).

A two-dimensional phenomenological theory of the negative glow is developed, considering a longitudinal magnetic field, negative ions, and an attachment term linear in the plasma density. Solving the diffusion equation by separation, one can compute the change of plasma density and plasma efficiency with the magnetic field. The influence of the longitudinal magnetic field on the parameters of the cathode fall is considered. At a given discharge voltage the growth of plasma efficiency (a boundary condition of cathode fall) with the magnetic field causes a diminution of the length of the dark space and an increase of the discharge current. If the glow is determined by recombination there are no changes of plasma density, plasma efficiency, dark space, and discharge current with the magnetic field. (auth)

32822 CATHODE FALL AND NEGATIVE GLOW OF ANOMALOUS GLOW DISCHARGES IN A LONGITUDINAL MAGNETIC FIELD. II. EXPERIMENTS IN H_2. Franck, G.; Schipp, F. (Univ., Munich). Z. Phys.; 235: 327-38(1970). (In German).

The model developed in Part I is proved experimentally in anomalous H_2-discharges. Probe measurements show that the plasma density of negative glow increases with magnetic field at low pressures ($p < 0.2$ torr) and low magnetic fields ($B < 300$ G). In this region the glow is determined by diffusion. At higher pressures or higher magnetic fields there is no change of plasma density with B and the glow is determined by recombination. In all pressure ranges the change of plasma density with magnetic field is described very well by the model. The H_2 glow is oscillation-free up to magnetic fields near 500 G. At constant discharge voltages the parameters of cathode fall (length of the dark space, discharge current) are changed with magnetic field too. It is shown that the influence of the magnetic field on cathode fall only is caused by the negative glow, whose efficiency δ is varied by the magnetic field. The change of δ from the model is in good agreement with experimental results. (auth)

32823 RADIATION CHARACTERISTICS OF LONGITUDINAL WAVES FROM AN ANTENNA IN A PLASMA. Shen, K.; Aksornkitti, S.; Hsuan, H. C. S.; Lonngren, K. E. (Univ. of Iowa, Iowa City). Radio Sci.; 5: 611-15(Mar 1970).

Experiments designed to measure the radiation patterns of a longitudinal wave excited in a warm plasma by both monopole and dipole antennas are described. The longitudinal wave used in this experiment is the low-frequency ion–acoustic wave that propagates with a phase velocity $[\gamma kT_e/M_i]^{\frac{1}{2}}$. Experimental results agree well with the theoretical predicted radiation pattern. (auth)

Kinetics (Experimental)

32824 STIMULATED EMISSION PRODUCED BY A LASER-CREATED PLASMA. Bobin, J. L.; Briquet, G.; Jego, J. M.; Terneaud, A. (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges, France). Phys. Lett.; 32A: 51(1 Jun 1970). (In French).

Stimulated emission centered at 10,750 Å is obtained from a laser-created plasma. The laser beam is focused in nitrogen at atmospheric pressure. (auth)

32825 DUST-INDUCED QUENCHING OF AFTERGLOW PLASMA. Dimoff, K.; Smy, P. R. (Univ. of Alberta, Edmonton). Phys. Lett.; 32A: 13-14(1 Jun 1970).

The rate of deionization of an afterglow plasma is found to increase by a factor of 50 when a cloud of dust particles is injected into the discharge region. This "quenching" of the plasma is in good agreement with theory. (auth)

32826 INVESTIGATION OF HIGH-CURRENT PULSE DISCHARGE IN ARGON. Babaev, I. K.; Sviridov, A. N.; Tychinski, V. P.; Tsys, S. N. Zh. Prikl. Spektrosk.; 9: 210-15(Aug 1968). (In Russian).

Pulse discharge in argon at pressures of the order of 10^{-2} torr and current densities up to 1000 A/cm^2 was studied. According to the volt–ampere characteristics of the discharge it is possible to determine the main parameters of the discharge—electron temperatures and electron density. Investigation of characteristics of such a discharge were studied under conditions corresponding to working regimes of pulsed ionic lasers (argon pressure 0.02 torr, diameter of discharge tube 5 mm, and amplitude of current pulses up to 200 A). Results of discharge characteristics are as follows: (A) relaxation time of the electrons was of the order of hundredths of microseconds, and the relaxation length was of the order of tenths of a centimeter; therefore, from the point of view of electron distribution according to discharge rates, it is possible to consider as steady-state; (B) electron distribution is close to Maxwellian; (C) electron concentration was determined from the condition of equality of ionization rate and the recombination rate, yet it was felt that the disappearance of charges occurs basically on walls; under the conditions studied, electron concentration changed almost linearly with current and reached 4×10^{14}/cm^3; and (D) electron temperature was evaluated from plasma conductivities in the center of the discharge tube (in addition, electron distribution was considered according to cross-section cells). It was found that, with current densities above 500 A/cm^2, the electron temperature depends little on current and has a value of 4.5 to 5 eV. (tr-auth)

32827 QUASI-STEADY PLASMA ACCELERATION. Clark, Kenn E.; Jahn, Robert G. (Princeton Univ., N. J.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 216-20(Feb 1970).

A coaxial plasma accelerator driven by protracted pulses of current in the range of 10^4 to 10^5 A and synchronized mass flows from 1.0 to 50 g/sec of argon attains, after some tens of μsec, a stable acceleration mode that replicates in every observable detail steady-flow self-field magnetoplasmadynamic acceleration. This "quasi-steady" discharge form is characterized by constant terminal voltage and arc current, a diffuse, fixed current distribution within the discharge, and a steady plasma efflux at velocities in excess of 10^4 m/sec. The device is thus of interest as a simulator of self-field arcjet operation which is much more amenable to detailed diagnostic study, and which can be extended to multimegawatt power levels totally inaccessible to steady flow testing. In addition, it may presage a repetitively pulsed quasi-steady thruster of high-efficiency and variable thrust capability. (auth)

32828 CURRENT-SHEET VELOCITY IN A COAXIAL PLASMA ACCELERATOR. Lie, T. N. (Catholic Univ. of America, Washington, D. C.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 206-10(Feb 1970).

Several factors which affect the velocity of the current sheet in a coaxial plasma accelerator such as the insulator ablation, the radius ratio of the electrode, the species of gas and its pressure are examined experimentally and the results are compared with the theoretical predictions. It appears that the ablation and possibly the degassing from the insulator wall provide severe ve-

locity drag and the detailed observations closely support the physical model on the ablation proposed by Keck. In general, however, the experimental values do not agree with a previous theory for the ablation. The cause for the disagreement is due to the fact that the velocity relation used in the previous analysis fails to account for the radius ratio of the coaxial accelerator. (auth)

32829 MEASUREMENT OF ATOMIC METASTABLE DENSITIES IN A PLASMA CREATED BY NUCLEAR RADIATIONS. Guyot, J. C.; Miley, G. H.; Verdeyen, J. T.; Ganley, T. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 13: 77-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32830 ABSORPTION OF He–Ne LASER RADIATION IN EXPLODED LITHIUM WIRE PLASMA. Oktay, Erol. Ann Arbor, Mich.; Univ. of Michigan (1969). 172p.

Thesis.

A continuous He–Ne laser radiation of $\lambda = 6328$ Å ($h\nu = 1.96$ eV) was passed through an exploding lithium-wire plasma. The absorption of radiation in the plasma was measured. Also measured were the electron density, neutral atom density, temperature, and the diameter of the plasma column. Values for the absorption of laser radiation were then calculated using these four measured plasma parameters. The calculated values of absorption were compared with those measured. (Disser. Abstr. Int., B)

32831 HELIUM METASTABLE CROSS SECTION MEASUREMENTS IN A HELIUM AND HELIUM–MERCURY PLASMA WITH A TWO-WAVELENGTH LASER HETERODYNE INTERFEROMETER. Cook, Harlan Joseph. Cleveland; Case Western Reserve Univ. (1969). 156p

Thesis.

A dual-wavelength laser heterodyne interferometer was used to study the excitation and de-excitation mechanisms of the helium metastable atom in a helium and a helium–mercury plasma. A two-body destruction process between a helium triplet metastable atom and a neutral helium atom for low-pressure discharges was observed rather than the three-body process involving an additional neutral helium atom as proposed by other researchers. The cross section for the two-body process was determined to be 9.3×10^{-21} cm^2. The diffusion coefficient for the diffusion of helium metastable atoms through neutral helium atoms was determined over a range of pressures to be 420 ± 42 cm/sec corrected to standard conditions (1 torr at 300°K). (TSS) (Diss. Abstr.)

32832 ONSET OF ROTATING DISTURBANCE IN THE INTERELECTRODE REGION AND EXHAUST JET OF AN MPD ARC. Allario, Frank; Jarrett, Olin Jr.; Hess, Robert V. (Langley Research Center, Hampton, Va.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 8: 902-7(May 1970).

Experimental results are presented of a parametric study of the onset of rotating disturbances ($f \leq 500$ kHz) in the plasma of a 15- to 40-kW MPD arc. Measurements were taken in the exhaust and interelectrode regions, using optical and electrostatic probes. The dependence of critical magnetic field (B_c) on mass flow, background pressure, and propellant is given. In argon, B_c varied from 800 to 1800 gauss for a mass flow change of 14 to 100 mg/sec. Considerably higher values of B_c were obtained in xenon. Little dependence on background pressure was found. Diagnostics were performed on the quiet preonset and the postonset plasma states. The latter evolved from a coherent disturbance at low B to an apparent turbulent state at high B. Thrust measurements in these different plasma states are discussed. The behavior of the onset of the rotating disturbance is similar to that found in a linear Hall-current accelerator. (auth)

Kinetics (Theoretical)

Refer also to abstracts 32616 and 32736.

32833 EXACT CALCULATION OF ELECTRON-BROADENING SHIFT FUNCTIONS. Klarsfeld, S. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 32A: 26-7(1 Jun 1970).

Closed-form expressions are given for various shift functions needed in the theory of electron-impact broadening of lines emitted by neutral atoms in a plasma. (auth)

32834 COLLISION-DOMINATED BOUNDARY LAYER IN A WEAKLY IONIZED PLASMA. Mueller, Karl Gerhard (Univ., Bonn); Wahle, Peter. Z. Naturforsch.; 25a: 525-38(Apr 1970). (In German).

A collision-dominated sheath model is developed that includes the well-known macroscopic models as extreme cases. A description of the charge carriers is set up with the help of the velocity distribution. In order to fulfill the microscopic boundary conditions at the wall, the velocity distributions are split into two parts. A basic set of new transport equations arises that differ from the usual equations by a correction term in the momentum transfer equations. Because of this splitting up of the velocity distribution, specular reflection of the electrons at the wall could be accurately accounted for. In a good approximation, the results can also be obtained from the usual equations, if a suitably fitted factor is introduced into the electron boundary condition at the wall. (auth)

32835 ESTIMATION OF THE MOST IMPORTANT PARAMETERS OF THE SPACE CHARGE LAYER FOR ION EXTRACTION. Fette, K.; Hesse, J. (Technische Univ., Brunswick). Z. Naturforsch.; 25a: 518-24(Apr 1970). (In German).

Ions extracted from a plasma often have to pass a space charge existing in front of the container wall. If collisions occur within the sheath, both the ion composition and the extraction efficiency may heavily be influenced. The parameters of interest are the extension and the field strength of the sheath. A theory is presented by which these quantities can be calculated. The theory holds for a positive space charge, the orifice being biased negatively with respect to the plasma potential. Numerical results are given concerning a weekly ionized nitrogen plasma. (auth)

32836 GREEN'S FUNCTION THEORY OF FIELD CORRELATIONS IN PLASMAS. Smith, Michael Jerome. Washington, D. C.; Howard Univ. (1969). 90p.

Thesis.

Modern theoretical techniques based on the application of Green's function methods are applied to the calculation of longitudinal and transverse dielectric functions in a neutral, isotropic, equilibrium plasma. These dielectric functions are used to calculate the electric field–field correlation function. In the plasma model used, the ions form a smeared positive background in which the electron gas is imbedded. For such a plasma, two classical Green's functions, which are solutions of Maxwell's equations in the Coulomb gauge, are related to the longitudinal and transverse dielectric functions respectively. These dielectric functions describe the system's response to external stimuli. Two quantum mechanical solutions are also obtained. To first order, these are found to be double-time, temperature-dependent, retarded Green's functions. The solution to Maxwell's equations is unique. Therefore, these quantum Green's functions are related to the classical Green's functions and thereby to the longitudinal and transverse dielectric functions. The quantum Green's functions mentioned above are calculated herein using a quantized, nonrelativistic Hamiltonian. With the help of this Hamiltonian, a hierarchy of equations of motion is established for each of the two Green's functions sought. Terminating these hierarchies allows a determination of these quantum Green's functions. They are compared with the classical Green's functions and explicit expressions for the longitudinal and transverse dielectric functions obtained. The retarded, double-time, quantum Green's functions, which depend upon the dielectric functions, have analytic properties which allow a determination of the electric field–field correlation function. It is shown by this technique that this correlation is determined by the dielectric functions. (Diss. Abstr. Int., B)

32837 TRANSPORT IN A MAGNETIC FIELD. I. THE GAUGE-INDEPENDENT FORMALISM. Van Zandt, L. L. (Purdue Univ., Lafayette, Ind.). Phys. Rev., B; 1: 3217-22(15 Apr 1970).

The problem of the dynamics of a system of charged particles in a constant magnetic field is transformed into one from which the constant field gauge has been removed. The Liouville equation assumes a different form in this formalism. A variational principle for generating approximate solutions to complex problems is presented. (auth)

32838 TRANSPORT IN A MAGNETIC FIELD. II. THE TRANSPORT EQUATIONS FOR AN ELECTRON GAS. Van Zandt, L. L. (Purdue Univ., Lafayette, Ind.). Phys. Rev., B; 1: 3223-34(15 Apr 1970).

The gauge-independent formalism of the previous discussion is applied to the construction of transport equations on the density, spin density, and current density of a degenerate electron gas. Interactions are included in a self-consistent field approximation. Scattering events are treated in a relaxation-time approximation. Three kinds of rf driving fields are considered: transverse magnetic, longitudinal electric, and transverse electric. (auth)

32839 BOLTZMANN EQUATION FOR A RELATIVISTIC PLASMA. Lupu, Gheorghe; Tataru, Petre (Div. of Theoretical Physics, Cluj). Rev. Roum. Phys.; 15: 59-62(1970).

Boltzmann's equation for a relativistic plasma is solved by expanding the distribution function in terms of unnormalized

spherical harmonics. For this purpose a one-component (electrons) plasma is considered, whose temperature is of the order of that necessary to produce fusion reactions ($KT \sim mc^2$). At these temperatures, the velocities of the electrons can be considered as relativistic, the time scale being, however, of classical type. The influences of electric and magnetic fields are taken into account. Collisions and quantum effects are neglected. (TSS)

32840 GENERAL-RELATIVISTIC COLLISIONLESS PLASMA. Schwartz, M. (St. John's Univ., Queens, N. Y.). Nuovo Cim.; 67B: 121-35(11 Jun 1970).

A nonrelativistic collisionless plasma model is generalized to the general-relativistic domain. By imposing sufficient restrictions and making use of several integrals, the coupled Einstein–Maxwell–Euler equations are reduced to six coupled, ordinary differential equations that may be solved numerically. The tangents to the null geodesics are exhibited as functions of the metric-tensor components. The normals to the characteristic surfaces for magnetohydrodynamic waves are also exhibited. The latter surfaces turn out to coincide with the surfaces generated by the streamlines. A space-like Killing vector, normal to the streamlines is also shown to exist. Finally, the Minkowski-space version of the model is considered and some explicit solutions are obtained, including a solution to a Boltzmann equation. (auth)

32841 DYNAMIC MAGNETOCONDUCTIVITY FOR A TWO-COMPONENT PLASMA. Chute, Philip Arthur. Athens, Ohio; Univ. of Ohio (1969). 158p.
Thesis.

A rigorous kinetic equation for a system of classical particles (electrons and ions) interacting via Coulomb potentials and the exact expression for the dynamic magnetoconductivity in the weak-coupling limit are established. The special case in which no magnetic field is present is also investigated, using the momentum wavefunctions. The connected-diagram expansion method was used to calculate the dynamic magnetoconductivity for a two-component plasma. A rigorous kinetic equation is developed for the electron one-body reduced density matrix in the weak-coupling limit; the ion result follows by analogy. The equation is then solved, yielding expressions for the zeroth- and second-order conductivity. Momentum states are used for the B = 0 case, while Landau states are introduced as the proper representation when a constant magnetic field is applied. The zeroth-order expressions yield the well-known results for the high-frequency conductivity. Closed-form expressions are obtained for the second-order conductivities; these results are expected to be valid for a sufficiently dilute system (Boltzmann statistics) and in the limit of high-frequency applied fields. In the limit of zero ion mobility, the electron-impurity results of Yamada (B = 0) and Chen-Fujita (B field) are recovered. (TSS) (Diss. Abstr.)

32842 TWO ASPECTS OF TRANSVERSE CHARGED PARTICLE DIFFUSION IN THE POSITIVE COLUMN. Mayer, Frederick Joseph. Cleveland; Case Western Reserve Univ. (1968). 60p.
Thesis.

Two distinct theoretical problems involving the transverse diffusion of charged particles in the positive column are reported. First, numerical solutions to the exact nonlinear electron and ion transverse balance equations are exhibited. These solutions represent an extension of the work of Allis and Rose, and Cohen and Kruskal on the positive column of a quiescent gas discharge. The transition from "free" diffusion to "ambipolar" diffusion is clearly depicted. A so-called "characteristic" curve for the positive column is presented, and the effects of different mobilities and temperature ratios are shown. Second, using classical ambipolar diffusion theory and the Stark effect, a theory is developed for the observed "pressure" shifts in the helium–neon laser. The dependence on discharge parameters of these shifts are determined and compared with existing experimental results. (Diss. Abstr.)

32843 COHERENT EMISSION AND ABSORPTION OF SYNCHROTRON RADIATION IN A RELATIVISTIC PLASMA. White, Ronald Keith. Lafayette, Ind.; Purdue Univ. (1969). 106p.
Thesis.

A test-particle approach is used to describe the synchrotron radiation spectrum of a homogeneous, fully ionized, relativistic electron plasma in a magnetic field. Using the Vlasov equation in relativistic form the dielectric tensor is developed and exploited to describe the reabsorption of the emitted radiation and the result is compared with that obtained from a conventional, nonplasma approach in the common domain of validity. Solving the Vlasov–Maxwell's equation for a single "bare" particle, the "dressed" test-particle, or quasi-particle, is calculated and described, and the superposition principle of Rostoker is used to describe the effect of particle correlations. The radiation model employed is one developed and successfully exploited by Birmingham and others with a variety of interesting radiation mechanisms, including synchrotron emission in a cold thermal plasma. Examples are given and numerical studies are made for the case of an isotropic power-law distribution of particle velocities, and a criterion is established relating the plasma density to the dominance of coherent emission for this interesting case. (Diss. Abstr.)

32844 UNIFIED KINETIC EQUATION OF PLASMAS. Aono, Osamu (State Univ. of New York, Buffalo). Ann. Phys. (N. Y.); 57: 381-5(Apr 1970).

The interaction term of the kinetic equation is expressed in the form of a sum of two terms: The one term is due to binary collisions between close particles, and the other is due to collective interactions among remote particles. This kinetic equation is exact up to the first order in the plasma parameter; the Coulomb logarithm is not necessarily large. (auth)

32845 NUMERICAL CALCULATION OF THE LINKED DISTRIBUTIONS OF POTENTIAL AND TEMPERATURE FOR HYDROGEN ARC DISCHARGES OF FINITE LENGTH IN AXIAL MAGNETIC FIELDS. Raeder, J.; Wirtz, S. (Institut fuer Plasmaphysik, Garching, Ger.). Z. Naturforsch.; 25a: 459-72(Apr 1970). (In German).

The energy balance is used to derive a partial differential equation for the heat flux potential in a rotational symmetric arc column of finite length. This equation is combined with a corresponding equation for the electric potential in order to calculate the distributions of temperature and electric potential for an arc discharge in a strong axial magnetic field. Because the coupling of the two equations is very complicated, all investigations have to be made numerically. The influence of mass flow is studied by taking into account drastically simplified distributions of the azimuthal and radial flow velocities. (auth)

Production

32846 EXPERIMENTAL INVESTIGATION OF PLASMA PRODUCTION BY IRRADIATING SOLID HYDROGEN FOILS WITH AN INTENSE PULSE LASER. Sigel, R. (Institut fuer Plasmaphysik, Garching, Ger.). Z. Naturforsch.; 25a: 488-503(Apr 1970).

Foils of solid hydrogen were irradiated with a giant-pulse ruby laser. The formation and expansion of the plasma produced this way were investigated by time-resolved absorption measurements, by streak and framing photography, by holographic interferometry and by time-of-flight and charge-collection measurements. The measurements yield a fairly complete picture of this process: After the initial breakdown in the solid a plasma is produced at the surface of the foil facing the laser. Owing to the high pressure of the plasma, the solid hydrogen is compressed by a shock wave. This allows the layer in which the plasma is produced to penetrate into the interior of the foil with a velocity of 3×10^6 cm/sec. Thus, under the action of the focused beam, foils up to 1 mm thickness are pierced by the light before the end of the pulse. The plasma cloud, ejected towards the laser, contains 4×10^{16} ions with a mean kinetic energy of 200 eV, this corresponding to about half of the absorbed energy. The observations are compared with the well-known results obtained in a plane, one-dimensional geometry. If allowance is made for the influence of the focusing of the laser beam on the structure of the shock front, the observations are readily understood. (auth)

32847 MOTION OF A FREE-BURNING ELECTRIC ARC IN AN OSCILLATING TRANSVERSE MAGNETIC FIELD. Bartels, K.; Uhlenbusch, J. (Physikalisches Institut, Aachen). Z. Angew. Phys.; 29: 122-5(1970). (In German).

The dynamical response of a low-current (I < 12 A) free-burning electric arc subjected to an oscillating transverse magnetic field (frequency 2 to 100 Hz) is described by a hydrodynamical model, representing the arc by an impermeable uniform cylindrical column. These calculations are favorably compared with measurements of the phase shift and amplitude of the oscillating motion of argon and nitrogen arcs. Electrode effects are eliminated by mounting cascades between the free-burning column and the electrodes. (auth)

Stability

32848 (ORO-3405-29) INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES. Annual Progress Report No. 5. (Maryland Univ., College Park. Inst. for Fluid Dynamics and

Applied Mathematics). 1 Jun 1970. Contaract AT(40-1)-3405. 24p. Dep. CFSTI.

Experimental research progress on drift instabilities in Q machines is reported. The material is divided into three sections: (1) wave-instability physics and plasma stabilization, (2) Q-machine technology, and (3) general experimental methods and technological spin-off possibilities. (M.O.W.)

32849 (ORO-3405-30) PERIODIC PULLING OF THE DRIFT INSTABILITY IN A THERMAL PLASMA. Abrams, R. H. Jr. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Jan 1970. Contract AT(40-1)-3405. 116p. (BN-642). Dep. CFSTI.

An analysis is presented of the perturbed van der Pol equation. The dispersion relation for the plasma drift wave is derived. The experimental apparatus, procedure, and results are described. (M.O.W.)

32850 STARK BROADENING FOR TURBULENCE STUDIES IN A CONFINED PLASMA. Levine, M. A.; Gallagher, C. C. (Air Force Cambridge Research Labs., Bedford, Mass.). Phys. Lett.; 32A: 14-15(1 Jun 1970).

Plasma turbulence produces enhanced broadening in the wings of Stark-broadened profiles. In a toroidal, high-β, plasma containment device, this mechanism established the presence of turbulence during the compression phase and the absence of turbulence during containment. (auth)

32851 CONJECTURES ON THE GLOBAL STABILITY PROBLEM OF PLASMOIDS. Hawkins, L. C. (Univ. of Miami, Coral Gables, Fla.). Phys. Lett.; 32A: 43(1 Jun 1970).

The variational calculations analyzing the global stability of high-β plasmoids are synthesized in two conjectures. These conjectures are subsequently made plausible. (auth)

32852 POSSIBILITY OF SUPPRESSING FLUTE INSTABILITY OF A DENSE PLASMA. Arsenin, V. V. JETP Lett. (USSR) (Engl. Transl.); 11: 173-5(5 Mar 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 267-9 (5 Mar 1970).

The stability of a cylinder of collisionless plasma with sharp boundary in a simple mirror field was investigated. Only surface wave-type perturbations were considered. Dispersion relations and conditions for stabilization of flute perturbations were obtained. (M.O.W.)

32853 ELECTROMAGNETIC INSTABILITY IN ELECTRON-CYCLOTRON-RESONANCE PLASMA. Gitomer, Steven Joel. Madison, Wis.; Univ. of Wisconsin (1969). 178p.

Thesis.

A plasma was produced in a magnetic mirror field by 1.5-μsec pulses of x-band microwave energy at the electron cyclotron frequency. The peak power delivered in a pulse was up to 100 kW, the repetition frequency was 360/sec, and the frequency was 8.54 GHz. The magnetic mirror ratios used were 1.02 and 1.19. Measurements were made of stored plasma energy density ($\simeq 2 \times 10^{13}$ eV/cm^3), electron density ($\simeq 5 \times 10^{10}$ electrons/cm^3), electron temperature ($\simeq 5 - 10$ keV), electron energy distribution, plasma light variations, and particle fluxes. An interpretation of the plasma behavior is presented. An instability was observed to occur in this experiment. Microwave emission was generated in a band of frequencies slightly below the frequency of the applied microwaves. The instability was also accompanied by particle losses along the direction of the dc magnetic field, variations in the plasma diamagnetism, and intense x-ray bursts. A number of theories are considered to explain plasma instability. One of these examines the stability of transverse electromagnetic waves propagating along the direction of the dc magnetic field in plasma having an anisotropic Maxwellian velocity distribution with loss cones. Calculations are made using the dispersion relation which results for such waves and predictions of the instability properties are made for the measured plasma parameters. The predictions are in good agreement with the experimental results. (Diss. Abstr. Int., B)

32854 DRIFT-DISSIPATIVE INSTABILITY IN AN ELECTROMAGNETIC FIELD. Teichmann, J. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett.; 32A: 47-8(1 Jun 1970).

The possibility of stabilizing the drift-dissipative instability by applying an electromagnetic hf field with a dominant magnetic component (low impedance) is discussed. (auth)

Thermonuclear Processes

32855 MAGNETIC SURFACES OF TOROIDAL HELICAL FIELD NEAR SEPARATRICES. Komin, A. V.; Krasitskaya, L. S.; Minaev, V. P. This paper was summarized in At. Energ. (USSR); 27: 221(Sep 1969) as paper No. 340/5202. (In Russian).

The magnetic surfaces, rotational transform angle, extent, and integral $B_0/L \int dl/B$ for a wide range of parameters are calculated for a helical toroidal magnetic field having the potential $\phi = R\varphi + R(ch\ \eta - \cos\theta)^{1/2} Q_m^m\ (ch\ \eta) \sin(n\theta + m\varphi)$. It follows from tentative calculations that the chosen potential provides a good description of the actual magnetic field in the stellarator. It is shown that in order to obtain a maximum extent throughout the entire volume, the optimum winding angle for the helical windings is 40 to 50°. A decrease in toroidality (ratio of the radius of the helical windings to the major radius of the system) from 0.2 to 0.02 increases the extent by a factor of 2 to 4; a further decrease in toroidality has almost no effect on the characteristics of the magnetic field. The maximum extent of a Z = 3 field is approximately two times greater than for a Z = 2 field. The obtained maximum vlaues, averaged over the radius of the extent, are ~0.22 (for a toroidality of 0.1 which is common for the experimental devices); this is completely sufficient for stabilizing most drifts in stabilities. As to be expected, the considered field does not possess a "minimum B on the average." (auth)

32856 COMPUTER SIMULATION OF A PLASMA ACCELERATOR. Watson, Velvin Richard. Stanford, Calif.; Stanford Univ. (1969). 163p.

Thesis.

A computer is used to simulate a collisionless plasma in an axisymmetric high-specific-impulse plasma accelerator with a constant applied electric field and with no applied magnetic field. The collisionless plasma model is shown to be applicable to plasma accelerators that operate with specific impulses in excess of 10^4 seconds and with particle number densities of the order of 10^{15} particles/cm^3 or less. In particular, the model is used to simulate an accelerator that has recently produced specific impulses of the order of 10^5 seconds with particle number densities of the order of 10^{15} particles/cm^3. (TSS) (Diss. Abstr. Int., B)

32857 FAST FUSION. Loup, Paul. Nucleus (Paris); 10: 299-304(1969). (In French).

The present definition of the phenomenon of fast fusion is given. Various studies that can contribute to this definition are briefly reviewed. Conditions of fusion without confinement, energy sources, experiments with plasmas, and fusion with marginal confinement are discussed. (J.S.R.)

Wave Phenomena

Refer also to abstracts 32737 and 32849.

32858 (IPP-3/102) EXPERIMENTS WITH BERNSTEIN WAVES. Leuterer, F. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Nov 1969. 87p. (In German). Dep. CFSTI (U. S. Sales Only).

Two Bernstein wave experiments are described. The first one is a transmission experiment in which the signal transmitted between two antennae immersed in the plasma is detected by means of a polar interferometer. Amplitude and phase of the received signal is thus recorded in the complex plane. The second experiment was performed to study the rf electric field within an inhomogeneous plasma column in which Bernstein wave resonances (Buchsbaum-Hasegawa modes) had been excited by means of an externally applied rf electric field. (M.O.W.)

32859 (NP-18256) THEORY OF PLASMA TURBULENCE FOR STRONG WAVE-PARTICLE INTERACTION. Rudakov, L. E.; Tsytovich, V. N. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1970. 28p. Dep. CFSTI (U. S. Sales Only).

A perturbation theory is developed, in the first approximation of which the strong interaction between waves and particles is considered near the resonance $\omega = \vec{k}\vec{v}$. There follows a useful prescription for the calculation of the nonlinear interaction. It is shown in what limit the usual approximations of perturbation theory may be applied. The effects of strong wave-particle interaction reduce the nonlinear interactions, e.g., in the case of ion-acoustic turbulence the nonlinear interaction with electrons is shown to be always small compared to the quasi-linear one, and for the case of Langmuir turbulence the effects of strong interaction become important in the nonlinear interaction if the noise level, w, is sufficiently high i.e., $w \gtrsim \eta T\, kr_D$, where η is the density, T the temperature, k the characteristic wave number and r_D the Debye length. (auth)

32860 (ORO-3405-31) INVESTIGATION OF LOW-FREQUENCY OSCILLATIONS IN A THERMAL PLASMA. Yadlowsky, E. J. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Jan 1970. Contract AT(40-1)-3405. 95p. (BN-641). Dep. CFSTI.

Dispersion relations for the lf oscillations that are expected in a Q machine are derived. Particular emphasis is given to ion–acoustic waves. An experimental analysis of the current-excited oscillations in a thermal plasma is described. Other studies discussed are: (1) nonlinear interactions between ion waves and drift waves, (2) standing ion–acoustic waves in a bounded moving plasma, and (3) parametric excitation of ion–acoustic waves. (M.O.W.)

32861 PROPAGATION OF COHERENT WAVES IN A WARM TURBULENT MAGNETOPLASMA. Youakim, Maurice; Liu, C. H. (Univ. of Illinois, Urbana). Radio Sci.; 5: 757-65(Apr 1970).

The problem of wave propagation in a warm magnetoplasma in the presence of random density fluctuations is studied. Using a perturbation technique similar to the renormalization procedure in field theory, a dispersion relation for plane coherent wave propagation is derived. For propagation along the magnetic field, the coherent longitudinal and transverse modes are found to be independent. But there is coupling among the modes for the random waves scattered by the irregularities. The coupling is strong for short correlation length of the turbulence. Attenuation constants for the coherent waves are obtained, and the effect of random scattering on the Faraday rotation phenomenon is discussed. (auth)

32862 EFFICIENT MODULATION COUPLING BETWEEN ELECTRON AND ION RESONANCES IN MAGNETOACTIVE PLASMAS. Wong, Alfred Y.; Baker, Dan R.; Booth, Newell (Univ. of California, Los Angeles). Phys. Rev. Lett.; 24: 804-7 (13 Apr 1970).

Modulation coupling between electron upper-hybrid modes and propagating nearly perpendicular to the axial magnetic field is shown to be effective in collisionless and semicollisionless regimes. A complete probeless feedback stabilization scheme based on such mode coupling is described. (auth)

32863 ANOMALOUS RESISTANCE OF A PLASMA IN THE CASE OF ION–ACOUSTIC TURBULENCE. Bekshtein, G. E.; Sagdeev, R. Z. JETP Lett. (USSR) (Engl. Transl.); 11: 194-7 (20 Mar 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 11: 297-300(20 Mar 1970).

The development of ion–acoustic turbulence for the case of a current flowing across the magnetic field was studied. The spectra energy density of the excited oscillations was described. An expression for the shock width is given. (M.O.W.)

32864 ION WAVES IN A HIGHLY IONIZED INHOMOGENEOUS HOLLOW CATHODE GAS FED ARC PLASMA IN A MAGNETIC FIELD. Schmidt, Heinz Alfred. Troy, N. Y.; Rensselaer Polytechnic Inst. (1969). 280p.

Thesis.

Plasma body rotation and self-excited low-frequency oscillations (ω, ω_{ci}) were studied in a highly ionized low-pressure hollow-cathode gas-fed arc device. Argon gas was used with a gas flow rate of 0.07 to 0.7 atm cm^3/sec corresponding to a background pressure range from 10^{-4} to 10^{-3} torr, and the electron density and electron and ion temperatures were of the order of 10^{13} cm^{-3}, 5 eV and 0.5 eV, respectively. The longitudinal magnetic field range covered was from 200 to 2000 gauss. The arc column was observed to rotate in the electron diamagnetic direction around B_z with speeds of up to 6×10^4cm/sec. The magnitude of this azimuthal rotation was used to determine the effective collision frequency for plasma transport across the magnetic field. The magnitude of the transverse diffusion coefficient is of the order of the Bohm diffusion coefficient but exhibits a classical $1/B^2$ dependence. The observed lf waves were identified as ion–acoustic and resistive drift instabilities by studying their dependences on neutral gas pressure, magnetic field, arc current, arc length and ion mass. Dispersion relations for linearized radially localized waves, which include the effect of charged particle–neutral atom collisions were derived. It was found that the ion–acoustic and drift-wave frequencies both decreased with increasing gas pressure, but increased with increasing magnetic field. No dependence on the magnitude of the arc current could be found. The phase angle between perturbed density and potential, (proportional to the linearized growth rate) for the ion–acoustic wave was $\leq 90°$, whereas for the drift wave the phase difference was between 150 and 180°. All these experimental observations are consistent with the predictions of the theory derived. The ion–acoustic wave was observed to be excited in the cathode sheath (at a gas pressure below 2×10^{-4} torr) under conditions that involve ion flow across the cathode sheath. This wave is strongly dependent on the magnitude of the plasma potential outside the cathode sheath and can be suppressed by increasing the magnetic field in the vicinity of the cathode. Anomalous-wave-induced diffusion was correlated with the ion–acoustic wave. (Diss. Abstr. Int., B)

32865 RADIATION AND SCATTERING OF ELECTROMAGNETIC WAVES FROM A CYLINDRICAL INHOMOGENEOUS PLASMA STRUCTURE. Wong, William C. Syracuse, N. Y.; Syracuse Univ. (1969). 143p.

Thesis.

Scattering problems investigated in this research consist of medium-frequency scattering at an oblique angle of incidence, and high-frequency scattering at normal incidence. Radiation problems studied include two-dimensional radiation from an axially slotted cylinder, three-dimensional radiation from an arbitrary aperture on a conducting cylinder, and three-dimensional radiation from a magnetic dipole. In the former two cases, the cylinder is coated with an inhomogeneous and anisotropic plasma sheath, and in the last case, the magnetic dipole is immersed in a radially inhomogeneous, isotropic plasma column. Closed-form solutions are obtained where possible. In cases where the governing equations do not yield closed-form solutions, stratification technique is used in conjunction with a newly introduced transmission coefficient matrix to obtain analytical solutions. (Diss. Abstr. Int., B)

32866 RADIATION FROM AN OPEN-ENDED WAVEGUIDE INTO AN INHOMOGENEOUSLY FILLED SPACE. Kostelnicek, Richard John. Urbana, Ill.; Univ. of Illinois (1969). 85p.

Thesis.

An analytic solution to the problem of radiation from an open-ended parallel-plate waveguide into a dielectric or plasma slab is obtained by an extension of the function-theoretic technique. The approach is to formulate expressions for the electromagnetic fields in terms of a discrete mode spectrum inside the waveguide and continuous mode spectra in the open-regions. Subsequent mode matching at the waveguide aperture plane and air/slab interfaces leads to an integral equation with certain boundary conditions. A solution of this equation allows the determination of the fields throughout the whole of space. However, this equation is not solved directly, but instead, an auxiliary integral equation is formed from the original equation by employing the known exact solution of the canonical problem, viz., radiation from an open-ended waveguide into free space. Use of the auxiliary equation has the advantage that it may be solved exactly in an asymptotic sense. It is this asymptotic solution that demonstrates that the correct edge condition is satisfied. Standard numerical techniques are applied for the solution of the auxiliary equation, and results giving the scattered fields and distribution of scattered power for a TEM incident mode are presented. Solutions for other problems which may be attacked by the present method are also given, viz., the flanged waveguide, a guide radiating into a reflecting screen, and the flanged guide radiating through a dielectric or plasma slab. The solution for each of these problems may also be obtained when the geometry is circular, and the procedure is indicated. Furthermore, as in the parallel-plate case, the edge condition is easily shown to be satisfied in circular geometry. (Diss. Abstr. Int., B)

32867 ELECTRON CYCLOTRON ECHOES FROM PLASMA. Bruce, Robert Lee. Stanford, Calif.; Stanford Univ. (1969). 146p.

Thesis.

The response of a plasma column was investigated in a magnetic field to one, two, or three electromagnetic pulses under conditions where collective effects between the charged particles can be ignored, and a single-particle model is applicable. The plasma response to a single pulse at the electron cyclotron frequency may be used as the basis of a diagnostic technique for obtaining collision data. The experimental method is described, and collision data obtained by this method are given for argon and neon. The effect of electron thermal motions on the accuracy of these results is considered, and the general limitations of the method are discussed. When the applied pulse frequency is far above the electron cyclotron frequency and plasma frequency, the plasma response may be used as a diagnostic for electron density. The method is described, and results are compared with data obtained by two other microwave techniques for electron density measurement. One of the merits of the method is its ability to give excellent time resolution of plasma electron density. (TSS) (Diss. Abstr. Int., B)

32868 STUDY OF THE PROPAGATION OF FAST MAGNETO–ACOUSTIC WAVES IN A PLASMA CYLINDRICAL COLUMN THROUGH WHICH A CURRENT OF CONSTANT DENSITY PASSES BY MEANS OF GEOMETRICAL OPTICAL TECHNIQUES. Deutsch, R. V.; Grosu, I. Rev. Roum. Phys.; 15: 63-71(1970).

A study is carried out on the propagation of fast magneto–acoustic waves inside a cylindrical plasma column in static equi-

librium. The equation of rays is developed for particular limits. A generalization of these results makes possible general conclusions on the steady-state oscillations of the plasma column, as well as on the particular characteristics of magneto-acoustic waves inside the plasma. (auth)

32869 LONGITUDINAL OSCILLATIONS IN A WEAKLY IONIZED PLASMA. Bogdanor, John Lytle. Columbia, Mo.; Univ. of Missouri (1969). 81p.
Thesis.

Two distinct approximations are developed for the collisional contribution to longitudinal monochromatic wave damping in a weakly ionized plasma. Both approximations rely upon the use of the Boltzmann-Vlasov equation in computing the electronic distribution function. Assuming the electron distribution function to relax to its initial unperturbed state leads to a nonlinear damping decrement which is, in general, a function of time. A constant damping decrement is shown to exist if either the assumed damping of the field or the collision frequency of the resonant electrons is assumed negligible. If the electronic distribution function is assumed to relax to the state inferred from the Boltzmann collision integral, assuming isotropic scattering, a direct collisional damping contribution differing by a factor of two from the previous method, results. The method of characteristics and the kinetic energy analysis of wave damping are illustrated using the improved model. (Diss. Abstr.)

32870 THEORETICAL INVESTIGATION OF ELECTROMAGNETIC WAVES OBLIQUELY INCIDENT UPON A PLASMA SLAB. Swift, Calvin Thomas. Williamsburg, Va.; Coll. of William and Mary (1969). 73p.
Thesis.

The problem of an electromagnetic wave, obliquely incident upon a plasma slab is considered as a boundary-value problem, using a self-consistent solution of the coupled linearized Vlasov and Maxwell equations. Power reflection, transmission, and absorption coefficients are derived under the assumption that all particles undergo specular reflection at the surfaces of the plasma slab. Although the analysis is valid for arbitrary slab thickness, computational results are presented for slabs that are thin compared to a wavelength. The results show that a series of resonances occur, attributable to the finite temperature of the plasma. The results further show that the resonances are Landau damped as the thermal velocity of the plasma electrons increases. It is shown that similar resonances can be predicted from the coupled linearized hydrodynamic Maxwell equations; however, as is well known, such a model does not predict Landau damping. The effects of a finite collision frequency are then included via a simple BGK collision term. The numerical computations vividly indicate that the resonances undergo severe damping for extremely small values of the collision frequency to signal-frequency ratio. Finally, the plasma capacitor problem is considered, and the results indicate that the longitudinal resonances have very similar characteristics to the plane wave resonances. (Diss. Abstr.)

32871 DETERMINATION OF THE COMPLEX REFRACTIVE INDEX OF A PLASMA BY A PROPAGATION METHOD FOR THE APPEARANCE OF REFLECTED WAVES. Muschler, W. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). Z. Naturforsch.; 25a: 482-7(Apr 1970). (In German).

In an earlier paper, a propagation method was described that allows simultaneous determination of electron concentration and electron-collision frequency in a slowly varying plasma, using its complex refractive index. A regular progressive damped wave was assumed. The treatment is extended here to the case where the original wave is superimposed by a reflected one. The calculations show that, for distinct points in the direction of wave propagation, the determination of both modulus and argument of the complex refractive index is again possible. The discrete sequence of measuring points does not restrict the local resolution of the method. (auth)

Shielding

Refer also to abstracts 31569, 31730, and 31748.

32872 (AAEC/TM-531) MONTE CARLO SHIELDING CALCULATIONS. McGregor, B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1970. 10p. Dep. CFSTI (U. S. Sales Only).

The problems studied concern neutron transmission through ordinary concrete shields and ducts. Before the study it was not known whether any of these problems were amenable to solution by the Monte Carlo method but all were in fact solved to adequate accuracy once the necessary technique had been established. For this class of problems the Monte Carlo method provides an accurate and practical method of calculation. The study highlighted the stringent data requirements for shielding calculations. In particular it showed that detail is required in the valleys of the total neutron cross section. (Australia)

32873 ACCURACY OF SIMPLIFIED SPHERICAL HARMONICS IN CYLINDRICAL SHIELDS INCLUDING VOIDS. Schmidt, E.; Gelbard, E. M. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 189-90(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32874 TIME-DEPENDENT NEUTRON AND PHOTON S_n TRANSPORT AND MONTE CARLO CALCULATIONS WITH SPECIAL EMPHASIS ON NUCLEAR WEAPONS EFFECT INVESTIGATIONS. Sandmeier, H. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 13: 267(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32875 THE S_n METHOD. Lathrop, K. D. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 13: 391-2 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32876 DEVELOPMENT AND USE OF ASYMMETRIC QUADRATURE TECHNIQUES IN DISCRETE ORDINATE TRANSPORT ANALYSES. Disney, R. K.; Soltesz, R. G. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 404-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32877 MOMENTS METHOD SOLUTION OF THE ADJOINT GAMMA-RAY TRANSPORT EQUATION. Morris, E. E.; Chilton, A. B. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 13: 405-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32878 EFFICIENCY OF LAGUERRE AND LEGENDRE QUADRATURES IN SHIELDING CALCULATIONS. Shure, K.; Swartz, L. M.; Wallace, O. J. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 406-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32879 GAMMA-RAY BUILDUP FACTORS AT LOW ENERGIES. Van Tuyl, H. H. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 407(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32880 ADJOINT S_n CALCULATIONS OF COUPLED-NEUTRON GAMMA-RAY TRANSPORT THROUGH CONCRETE SLABS. Roussin, R. W. (Oak Ridge National Lab., Tenn.); Schmidt, F. A. R. Trans. Amer. Nucl. Soc.; 13: 408(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32881 EVALUATION OF HIGH-ENERGY (400 MeV) SPACE-PROTON-INDUCED SECONDARIES IN ALUMINUM. Curtis, S. B. (Univ. of California, Berkeley); Wilkinson, M. C. Trans. Amer. Nucl. Soc.; 13: 409(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32882 EXPERIMENTAL INVESTIGATION OF PHOTON-INDUCED SECONDARY ELECTRON EMISSION. Smith, Craig B. (Univ. of California, Los Angeles); Spencer, Russell B. Trans. Amer. Nucl. Soc.; 13: 409-10(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32883 CALCULATION OF THE RADIONUCLIDE PRODUCTION IN TISSUE BY SOLAR-FLARE BOMBARDMENT. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 410-12(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32884 DIFFERENTIAL MEASUREMENTS AND CALCULATIONS OF FAST-NEUTRON AIR-GROUND INTERFACE EFFECTS. French, R. L.; Mooney, L. G. (Radiation Research Associates, Inc., Forth Worth, Tex.). Trans. Amer. Nucl. Soc.; 13: 424 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32885 TIME-DEPENDENT FAST-NEUTRON AND SECONDARY GAMMA-RAY SPECTRUM MEASUREMENTS IN CONCRETE. Kendrick, H.; Harris, L. Jr.; Sperling, S. M. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 424-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32886 MONTE CARLO ANALYSIS OF IN- AND DOWN-SCATTERED RADIATION. Hinkley, D. E. (Catholic Univ. of America, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 425-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32887 GAMMA-RAY ATTENUATION IN STRUCTURES WITH BASEMENTS. Hinkley, D. E.; French, R. L. (Radiation Research Associates, Inc., Fort Worth, Tex.). Trans. Amer. Nucl. Soc.; 13: 426(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32888 REFRACTORY PARTICLE CLOUDS FOR THERMAL RADIATION SHIELDING AGAINST NUCLEAR BLASTS. Williams, J. R.; Byrn, N. R. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 13: 427(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32889 BACKSCATTERED NEUTRON ENERGY DISTRIBUTION FROM ALUMINUM AND PERSPEX. Segal, Y.; German, U. (Technion-Israel Inst. of Tech., Haifa). Trans. Amer. Nucl. Soc.; 13: 427-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32890 PASSAGE OF THERMAL AND INTERMEDIATE NEUTRONS THROUGH A SHIELDING NONUNIFORMITY. Broder, D. L.; Kozlovskii, S. A.; Kyz'yubov, V. S.; Popkov, K. K.; Smetanin, A. A. This paper was summarized in At. Energ. (USSR); 27: 142(Aug 1969) as paper No. 328/4753. (In Russian).

A procedure is proposed for calculating the passage of intermediate and thermal neutrons through cylindrical channels and plane slits; experimental verification of the validity of the procedure is reported. This procedure consists of a calculation of the direct flux component (the direct-vision component) by ray analysis, a determination of the reflected contribution by the Simon–Clifford method, and a calculation of the flux component associated with "leakage" of neutrons from the walls of the channel or slit based on an integration over the surfaces of these walls. In the integration, the drop in the specific intensity of the surface sources along the length of the channel or slit on the basis of an assumed sinusoidal angular distribution of particles is taken into account. The many experiments carried out with a reactor and also with the use of plane, isotropic neutron sources showed that this procedure provides for agreement between calculated and experimental results no worse than within 30%. Various situations were used in the experiments: direct cylindrical channels and rectangular slits irradiated by a source at the entrance of the channel or in line with the channel or slit; cylindrical channels and rectangular slits with projections; and displaced systems, i.e., channels or slits consisting of two parallel sections held at some distance from each other. (auth)

32891 MONTE-CARLO CALCULATION OF NEUTRON PENETRATION THROUGH CYLINDRICAL POLYETHYLENE LAYERS. Miroshnikov, G. V.; Solodukhin, I. A.; Miroshnikova, A. I. This paper was summarized in At. Energ. (USSR); 26: 372-3(Apr 1969) as paper No. 278. (In Russian).

The transmission of neutrons having initial energies of 14, 8.5, 6, 4.3, 3, 2, 0.8, 0.3, and 0.025 MeV through cylindrical layers of polyethylene 5 to 40 cm thick with outside diam. of 120 and 40 cm was calculated on a computer by the Monte Carlo method. The calculation was performed both for a narrow monodirectional neutron beam incident at various points A, B, and C on the surface and for a broad beam incident at various angles α with the axis of the cylinder. From five to ten thousand neutron trajectories were calculated for each case. All processes by which neutrons interact with hydrogen and carbon nuclei were taken into account in the calculations. Inelastic scattering of neutrons from carbon nuclei was assumed isotropic in the laboratory system. The following basic parameters were determined in the calculation: (1) the number of neutrons passing into the inner hollow of the cylinder and their distribution in energy and along the x axis in each energy interval; and (2) the number of neutrons reflected from the cylindrical layers and their energy distribution. (auth)

Solid-State Physics

Refer also to abstract 31453.

Radiation Effects

32892 (AD–700579) EFFECT OF GAMMA IRRADIATION ON THE ELECTRICAL CHARACTERISTICS OF SPECIALLY PURE SILICON. Starodubtsev, S. V.; Mikhaelyan, B. M.; Lyutovich, A. S.; Sinyukov, V. A.; Suvorov, A. N. Translated by D. Koolbeck from pp 127-33 of Fizicheskie Svoistva Osobo Chistykh Metallov i Poluprovodnikov, Tashkent, 1966. 12p. (FTD-HT-23-537-68). CFSTI.

Earlier research showed that silicon with low impurity content does not change its resistivity when bombarded by fast electrons. The present article describes the results of irradiation of highly purified silicon with γ rays. Single-crystal silicon was obtained by crucible-less zone melting in highly purified hydrogen. The change in the electric characteristics was determined by measuring the Hall effect and the resistivity at temperatures from 160 to 330°K. Plots are presented of the dependence of the relative change in the Hall mobility of the carriers on the gamma irradiation dose, of the temperature dependence of the Hall mobility for pure and ordinary samples, the relative change of carrier density as a function of the gamma irradiation dose, and the temperature dependence for the pure and ordinary samples, as well as the temperature dependence of the Fermi levels calculated from the experimental data. The results show that whereas in ordinary samples the number of carriers gradually decreased with increasing dose, pure samples showed a marked increase with increasing density, above a certain minimal dose. (auth) (USGRDR)

32893 (N–70-17167) OPTICAL ABSORPTION IN FUSED SILICA DURING IRRADIATION AT HIGH TEMPERATURE. (United Aircraft Corp., East Hartford, Conn.). Nov 1969. Contract NASw-847. 64p. (NASA-CR–107838; H–930709-1). CFSTI.

In situ optical experiments were conducted to determine the level of radiation-induced optical absorption that exists in Corning Grade 7940 fused silica at elevated temperatures during 1.5-MeV electron irradiation and during nuclear reactor irradiation. The optical absorption was measured at the peak of the strong radiation-induced absorption band in fused silica centered at 2150 Å over a range of specimen temperatures from 170 to 900°C. Several additional measurements were made at longer wavelengths (2700 and 4500 Å) to investigate the width of the absorption band and to check the absorption where strong absorption bands are not expected to exist. The electron irradiation experiments were conducted using a Dynamitron electron accelerator as a source of 1.5-MeV electrons. The induced absorption and specimen temperature were measured before, during, and after the irradiation; transient as well as steady-state data were obtained. The nominal irradiation time for the electron irradiation experiments was 1000 sec. (auth) (STAR)

32894 (N–70-18682) STUDY OF DOPANTS FOR RADIATION-RESISTANT SILICON. Quarterly Report. (Northrop Corporate Labs., Hawthorne, Calif.). Jan 1970. Contracts NAS7-100; JPL-952523. 17p. (NASA-CR–108037; NCL–70-1-R). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

Minority carrier lifetime degradation by ^{60}Co gamma radiation was investigated in bulk silicon containing aluminum, boron, or diffused lithium. The results indicate that Al- and Li-doped materials are significantly more sensitive to this type of radiation than are comparable B-doped materials. These results are particularly surprising because they appear to contradict previous reports of enhanced radiation resistance of Al-doped bulk material and of Li-doped solar cells. One explanation for the apparent contradictory behavior of these materials may be the fact that their electrical properties are extremely sensitive to pre-irradiation heat treatments. The use of the proper treatment is consequently expected to influence the radiation response. Differences might also exist because of device effects not present in bulk material and because of dose and injection level dependences. (auth) (STAR)

32895 (ORNL–4526, pp 1-17) RADIATION DAMAGE. (Oak Ridge National Lab., Tenn.).

CADMIUM — radiation damage in, annealing recovery of thermal-neutron

COPPER — radiation damage clusters in, fast-neutron

ELECTRONS—effects on alkali metal halides, mobility of negative ion vacancies produced in
—effects on magnesia, energy dependence of zero-phonon defects produced in
—effects on magnesia, luminescent
GOLD—radiation damage in, decay effects and annealing of thermal-neutron
GRAPHITE—radiation damage mechanisms in, theoretical and experimental studies of
MAGNESIUM OXIDES—radioinduced luminescence of crystals of, electron and neutron
—radioinduced zero-phonon defects in, energy dependence of electron
NEUTRONS—effects on magnesia, luminescent
NEUTRONS, FAST—effects on copper, defect clusters produced in
NEUTRONS, THERMAL—effects on cadmium, annealing recovery of
—effects on gold
POTASSIUM BROMIDES—vacancy defect mobility in electron-irradiated
POTASSIUM CHLORIDES—vacancy defect mobility in electron-irradiated
POTASSIUM FLUORIDES—vacancy defect mobility in electron-irradiated
RUBIDIUM BROMIDES—vacancy defect mobility in electron-irradiated
RUBIDIUM CHLORIDES—vacancy defect mobility in electron-irradiated
RUBIDIUM IODIDES—vacancy defect mobility in electron-irradiated
SODIUM CHLORIDES—vacancy defect mobility in electron-irradiated (D.L.C.)

32896 (ORNL-4526, pp 24-34) SURFACE STUDIES, X-RAY DIFFRACTION, AND CHANNELING. (Oak Ridge National Lab., Tenn.).

COPPER—defects in electrodeposited
—dislocation effects on x-ray diffraction properties of crystals of
CRYSTALS—ion channeling in, calculations of critical angle and minimum yields in, (T) (D.L.C.)

32897 ATOMIC FREQUENCY AND ENTROPY IN ANNEALING OF DEFECTS IN SILICON. Hirata, M. (Boston Coll., Chestnut Hill, Mass.); Hirata, M. Phys. Lett.; 31A: 544-5(18 May 1970).

The anomalously large value of the frequency factor observed in the annealing of the radiation-induced defects in silicon is explained by a relationship between the microscopic frequency factor and the observed relaxation time. (auth)

32898 EFFECTS OF ^{60}Co GAMMA IRRADIATION ON EPITAXIAL GaAs LASER DIODES. Barnes, C. E. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., B; 1: 4735-47(15 Jun 1970).

The characteristics of defects introduced in epitaxial GaAs by room-temperature ^{60}Co irradiation have been studied by observing the degradation of light emission from GaAs laser diodes. The luminescence degradation is indicative of a decrease in electron lifetime in the p-type region brought about by the introduction of nonradiative recombination centers. These defects anneal in a single stage centered at 237°C. Isothermal-annealing studies show that the defects anneal by a first-order kinetic process with an activation energy of 1.7 eV and a preexponential factor of 10^{13} sec^{-1}. The annealing properties of the defect suggest that it is a complex whose dissociation is the limiting step in the recovery process. The defects can also anneal at temperatures as low as 76°K under the influence of a strong forward bias. A dc forward bias at 2.2×10^2 A/cm^2 at room temperature for 1 hr produces complete recovery of the light intensity. The possibility of annealing due to heating while under strong forward bias has been considered and does not appear to be responsible for the bias annealing. Rather, the forward-bias-induced recovery is thought to be due to an increase in the probability of annihilation because of a change in charge state of the defect complex following capture of a minority carrier. The various aspects of forward-bias annealing observed in this study can be explained by this model. On the basis of the above results, the complex has been tentatively identified as consisting of an impurity and an As interstitial. (auth)

32899 OBSERVATION OF A NEW Gd^{3+} ESR CENTER IN IRRADIATED CaF_2. Bevolo, Albert J.; Lee, Sook (St. Louis Univ.). Phys. Rev. Lett.; 24: 1276-8(8 Jun 1970).

A new type of Gd^{3+} ESR center was observed in the CaF_2 lattice. This new Gd^{3+} center is produced as a result of x irradiation of CaF_2 crystals originally containing the tetragonal Gd^{3+} center charge compensated by an F^- ion. The crystal-field splitting associated with this new center is trigonally symmetric along the [111] axis of the CaF_2 lattice and is characterized principally by $b_2^0 \approx 2899 \times 10^{-4}$ cm^{-1}. (auth)

32900 THERMOLUMINESCENCE OF KCl:Tl BETWEEN 30 AND 400°C DETERMINED BY SIMULTANEOUS INTENSITY AND SPECTRAL DISTRIBUTION MEASUREMENTS. Mattern, P. L. (Brookhaven National Lab., Upton, N. Y.); Lengweiler, K.; Levy, P. W.; Esser, P. D. Phys. Rev. Lett.; 24: 1287-91(8 Jun 1970).

The thermoluminescence of KCl : Tl following gamma-ray irradiation was studied using a new technique. Most of the emission occurs at 3050 Å, but three weak bands also appear. The 3050-Å flow curves, after different doses, consist of one or more peaks from a set of seven peaks occurring between 312 and 537°K. The total 3050-Å emission increases and then decreases, and the most intense glow peak shifts from low to high temperature with increasing dose. (auth)

32901 EFFECT OF CHARGED DISLOCATION ELECTRIC FIELD ON COLOR CENTERS. Turchanyi, G.; Tarjan, I. (Research Lab. on Crystal Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 28: 291-301(1970).

The electric field originating from dislocations created in ionic crystals by deformation was applied to induce photoconduction. It was found that local maxima appeared in the photoconduction at certain wavelengths characterizing the crystals studied and the value of these maxima was usually higher than the corresponding value obtained in the F-band maximum of the given crystal. The phenomenon can be related to the Stark effect of color centers produced by the internal electric field. (auth)

32902 FORMATION OF I CENTERS IN LiF UNDER ELECTRON IRRADIATION. Farge, Yves (Cornell Univ., Ithaca, N. Y.). Phys. Rev., B; 1: 4797-4802(15 Jun 1970).

The lithium interstitial model (antimorph of the H center) for the defect associated with the 5430-Å absorption band formed in LiF by electron or neutron irradiation at 77°K is strongly supported by new experimental results: the creation rate of these defects is proportional to the incident electron flux, is independent of the F-center creation rate, and increases with the thickness of the sample, in good agreement with a knock-on process. (auth)

32903 INFRARED ABSORPTION IN REACTOR-IRRADIATED OXYGEN-CONTAINING GERMANIUM. Lin, K. C.; Chang, S. P. (Union Industrial Research Inst., Hsinchu, Taiwan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 81-2(1969).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Irradiations of oxygen-free and oxygen-containing specimens were performed in beam ports or vertical tube of the open-pool Tsing Hua Univ. reactor at a thermal neutron flux of 3×10^{12} to 5.2×10^{12} nv. Upon irradiation the 11.6-μ band in oxygen-containing Ge decreases with integrated neutron flux. For specimens containing $\sim 3 \times 10^{17}$ oxygen atoms per cm^3, this band was reduced to $\sim$1/4 and 1/2 of its original value by an integrated flux of 4×10^{17} and 7×10^{17} n/cm^3, respectively. In addition, reactor irradiation of oxygen-containing Ge also produced prominent new absorption bands at 13, 13.3, and 13.8 μ and some other weak bands in the range 12 to 15 μ. The 13 and 13.8-μ bands produced by reactor neutron irradiation have been observed previously under 2-MeV electron irradiations. This similarity suggests that the reactor-neutron-induced new absorption bands are likely associated with oxygen-defect complexes (i.e., oxygen coupled to radiation-induced primary defects) of various species. (L.M.T.)

32904 LUMINESCENCE OF γ-IRRADIATED SILICA GEL ON SORPTION OF GASES: "RADIOSORPTIONLUMINESCENCE." Rabe, J. G.; Breitkreutz, K. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Z. Naturforsch.; 25a: 571-2(Apr 1970). (In German).

Luminescence was observed on exposure of γ-irradiated silica gel to various gases and vapors. The emission spectrum has a maximum at 450 nm and is identical with the spectrum of radiothermoluminescence (RTL) under vacuum with a peak at 55°C. After radiosorption luminescence (RSL) at 20°C, the thermoluminescence at 55°C is decreased. The effect of RSL shows that sorbed gases can cause recombination of charges trapped in the gel. (auth)

32905 DIFFRACTION CHANNELING OF ELECTRONS AND POSITRONS IN CRYSTALS. Skoff, Gerald Franz. Cleveland; Case Western Reserve Univ. (1969). 161p.

Thesis.

The effect of specimen orientation on the transmission of narrow beams of electrons and positrons through thin, monocrystalline targets was investigated. A theory was developed which is based

on the matrix formulation of the dynamical theory of electron diffraction. Calculations were performed for the three major planes and axes in face-centered and diamond cubic lattices, and numerical results were obtained for the cases of copper and silicon crystals. The experimental part of the project was aimed at providing a check of the theory. A vacuum chamber was designed which had a goniometer type target holder in order to make possible a change in the angular orientation of the target. Monochromatic electrons were obtained by using a magnetic momentum selector on the continuous spectrum from a strong (20 mCi) ^{32}P source. An activated, small-area Cu foil was used as the positron source. The targets were thin, single-crystal foils (about 20-μ thick) of copper and silicon, and the transmitted intensity was measured with a silicon surface barrier detector. Agreement between theory and experiment on a qualitative basis is very good. In general, positrons penetrate more along a major crystal axis, whereas electrons can have both increased and decreased transmission, depending on target orientation and energy. Crystals of a high atomic number were found to show stronger directional effects than low atomic number materials. (Diss. Abstr. Int., B)

32906 PROTON CHANNELING TO OBSERVE THERMAL RELEASE OF IMPLANTED IONS. Bacharach, S. L.; Taylor, A. (Cornell Univ., Ithaca, N. Y.). Trans. Amer. Nucl. Soc.; 13: 131(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

32907 NATURE OF STRENGTHENING γ-IRRADIATED NaCl AND KCl CRYSTALS. Kuzmenko, P. P.; Makara, V. A.; Novikov, N. N. (Kiev State Univ.). Ukr. Fiz. Zh.; 15: 654-61(Apr 1970). (In Russian).

The influence of different doses of γ irradiation on the dislocation mobility in NaCl and KCl single crystals was studied by observing the ray length of the dislocation rosettes. The absorption spectra of these crystals were studied simultaneously. The results obtained make it possible to conclude that the influence of color centers on mobility of dislocations is insignificant. (auth)

32908 SATURATION OF THE V_3 BAND FORMATION IN KCl UNDER ELECTRON IRRADIATION AT ROOM TEMPERATURE. Herrmann, Friedrich; Pinard, Pierre (Institut National des Sciences Appliquees, Lyon). Solid State Commun.; 8: 791-3 (May 1970).

It is shown that the V_3 band in KCl under 30-keV electron irradiation at room temperature grows proportionally to the F band up to concentrations near saturation, the constant of proportionality being independent of radiation intensity and sample origin. This confirms that the F and V_3 centers are complementary defects. The oscillator strength of the V_3 band is calculated. (auth) (UK)

32909 PHASE-FORMING PROCESSES IN TANTALUM FILMS THROUGH SPUTTERING. Nakamura, Masashi; Fujimori, Masatoshi; Nishimura, Yasuro (Fujitsu Labs. Ltd., Kawasaki, Japan). Jap. J. Appl. Phys.; 9: 557-71(May 1970).

For the formation of tantalum films by sputtering at a lower gas pressure, α-tantalum is deposited in a contaminative atmosphere, while β-tantalum is deposited in a clean atmosphere. The latter phenomenon can be thought of as the quenching of sputtered tantalum atoms by direct collision with the substrate when no layers of adsorbed impurity gas exist. At a higher pressure, the phase transition to β-Ta can be caused by the incorporation of discharge gas and thermal effect. For tantalum nitride, there is a certain region where the characteristics of the films are insensitive to the nitrogen partial pressure. The extent of nitridation is considered to be determined by the density ratio between the number of nitrogen molecules on the substrate and that of the incoming tantalum atoms. Within this region, the ratio is constant, so a stable film with a low energy state and stoichiometric structure whose main content is Ta_2N is formed. (auth)

32910 THERMOLUMINESCENCE AND COLOR CENTER CORRELATIONS IN DOSIMETRY LiF. Mayhugh, M. R.; Christy, R. W.; Johnson, N. M. (Dartmouth Coll., Hanover, N. H.). J. Appl. Phys.; 41: 2968-76(Jun 1970).

Dosimetry LiF was γ irradiated up to 10,000 R, and the resulting thermoluminescence was studied above room temperature in conjunction with the optical absorption between 190 and 400 nm. Changes in the glow curves and absorption spectra after various optical and thermal treatments show that the thermoluminescence process begins with thermal release of electrons from centers causing optical absorption in the 310–380-nm region. Moreover, the centers causing the important dosimetry glow peaks near 200°C appear to have two excited states, so that these centers have optical absorption bands at both 310 nm and under the F band at 250 nm. In particular two glow peaks near 200°C are correlated with two 310-nm absorption bands which are distinguished by different optical bleaching rates. For the glow peak usually used for dosimetry, the correlation is supported by an equality of thermal activation energies for the glow peak and 310-nm band. To interpret all the data in terms of these correlations requires assuming a restriction in the availability of luminescence sites. Implications for the photon production mechanisms and the trap structures are discussed. An asymmetry in the F band of LiF, as if a large K band were present, is also found. (auth)

32911 THE BrO_2 CENTRE IN IRRADIATED ZINC BROMATE. Collins, M. A.; Cosgrove, M. M.; Betteridge, G. P. (Dept. of Scientific and Industrial Research, Lower Hutt, N. Z.). J. Phys., B (London); 3: L48-51(May 1970).

An ESR spectrum corresponding to $S = \frac{1}{2}$, $I = \frac{3}{2}$, and showing orthorhombic symmetry was detected in single crystals of γ-irradiated zinc bromate. First-order analysis of the spin Hamiltonian produced the parameters: (i) $g_{xx} = 2.004$, $g_{yy} = 2.054$, $g_{zz} = 2.067$, $|A_{xx}| = 447$ G, $|A_{yy}| = 163$ G, $|A_{zz}| = 120$ G; (ii) $g_{xx} = 2.005$, $g_{yy} = 2.056$, $g_{zz} = 2.068$, $|A_{xx}| = 483$ G, $|A_{yy}| = 172$ G, $|A_{zz}| = 121$ G. The paramagnetic centers characterized by these parameters are tentatively identified as the $^{79}BrO_2$ and $^{81}BrO_2$ radicals. (auth) (UK)

Physical Properties

Refer also to abstracts 32390, 32400, 32448, 32450, 32495, 32514, and 32633.

32912 (EUR-4414) STUDIES ON NEUTRON MONOCHROMATOR CRYSTALS HAVING A LATTICE SPACING GRADIENT, [PART] I. Rustichelli, F. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 18 Sep 1969. 30p. (In Italian). Dep. CFSTI (U. S. Sales Only). Lit. 620.

A theoretical analysis of the utilization as neutron monochromators of crystals with a gradient of lattice spacing is given. The possibility of utilizing such crystals in composite monochromator systems is investigated. Finally, the techniques used to produce crystals with a gradient of the lattice spacing and the first experimental results are described. (auth)

32913 (IAE-1890) DYNAMIC THEORY OF X-RAYS IN CRYSTALS WITH DEFECTS. Afanas'ev, A. M.; Kon, V. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1969. 36p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Sets of integral equations are obtained that describe the x-ray diffraction in crystals with defects. A simple description of defects is suggested both for weakly as well as strongly distorted regions of the crystal. In the case of ideal crystals, the equations give a simple means of determination of wave fields in the crystal with an arbitrary incident beam distribution. For Bragg diffraction, the problem is solved for the first time, the solution being given for crystals of arbitrary thickness. For distorted crystals, the integral equations permit a universal treatment of both weakly and strongly distorted regions. The problem of image determination from strongly distorted regions is confined to the problem of solving of a simple one-dimensional integral equation. The first iteration approximation of the initial integral equations is shown to give the results obtainable by Fourier analysis, with the defect being treated as a small perturbation. (auth)

32914 (NP-18254) SPIN ECHO IN NONFERROMAGNETIC METALS. Baikov, I. S. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). 1970. 13p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The theory of linearized spin echo in a degenerate electron gas was applied to the case of an arbitrary oriented spin wave vector and magnetic field gradient in relation to the direction of the external magnetic field. It is shown that spin-echo experiments can be used for determining the virtual part of the generalized spin-wave diffusion coefficient. (tr-auth)

32915 (ORNL-4526) SOLID STATE DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1969. (Oak Ridge National Lab., Tenn.). Feb 1970. Contract W-7405-eng-26. 125p. Dep. CFSTI.

Research is reported in the following section areas: radiation damage; dislocations and radiation effects on plastic deformation; surface studies, x-ray diffraction, and channeling; electronic and optical properties; electron spin resonance; magnetic properties; lattice dynamics; low-temperature properties; research materials;

and experimental equipment and new techniques. Separate abstracts were prepared for each section. (D.L.C.)

For abstracts of individual sections see: 31535, 32470, 32524, 32762, 32895, 32896, 32916–32918, and 32931.

32916 (ORNL-4526, pp 34-43) ELECTRONIC AND OPTICAL PROPERTIES. (Oak Ridge National Lab., Tenn.).

ALKALI METAL HALIDES—F-band pressure-shift calculations
COPPER—Fermi surface of, calculation of phase shifts for, (T)
ELECTRONS—effects on potassium magnesium fluoride crystals, thermoluminescent
POTASSIUM CHLORIDES—F-center hyperfine interaction in
POTASSIUM MAGNESIUM FLUORIDES—radioinduced thermoluminescence spectra of $KMgF_3$ crystals, electron
URANIUM—compounds, electron band structure calculations for paramagnetic (D.L.C.)

32917 (ORNL-4526, pp 51-64) MAGNETIC PROPERTIES. (Oak Ridge National Lab., Tenn.).

CERIUM ALLOYS & SYSTEMS—Ce-Y, Kondo state in, neutron-scattering study of
DYSPROSIUM ALLOYS & SYSTEMS—Dy-Ho, magnetization process in
GADOLINIUM—magnetic form factor of, polarized-neutron study of
HOLMIUM—spin-wave dispersion relation of metallic, neutron-scattering study
VANADIUM OXIDES—Cr_2O_3-V_2O_3-base, magnetic structure of (D.L.C.)

32918 (ORNL-4526, pp 64-75) LATTICE DYNAMICS. (Oak Ridge National Lab., Tenn.).

AMMONIUM CHLORIDES—torsional mode in, neutron scattering study of
GRAPHITE—lattice dynamics of, neutron inelastic scattering study of
HOLMIUM—phonon spectrum
INDIUM—phonon dispersion curves
IODINE—lattice dynamics of, neutron inelastic scattering study
MANGANESE FLUORIDES—phonon dispersion curves in MnF_2
POTASSIUM CHLORIDES—KCl-base-NH_4Cl, phonon measurements in
RUTILES—phonon spectra of (D.L.C.)

32919 ELECTRONIC BAND STRUCTURE AND OPTICAL PROPERTIES OF GRAPHITE FROM A VARIATIONAL APPROACH. Painter, G. S. (Oak Ridge National Lab., Tenn.); Ellis, D. E. Phys. Rev., B; 1: 4747-52(15 Jun 1970).

The electronic band structure of graphite was calculated from an ab initio variational approach using a linear combination of atomic orbitals (LCAO) basis of Bloch states, including nonspherical terms in the one-electron crystal potential. Matrix elements of the Hamiltonian are evaluated directly without any tight-binding approximations. The optical transitions deduced from the energy bands calculated using a single-layer crystal model agree nicely with recent polarized-light reflectance measurements. Details of the band structure are calculated for the three-dimensional Brillouin zone and related to the results obtained using the single-layer crystal structure. The results are encouraging, not only from the standpoint that the method employed is an ab initio approach with no special a priori assumptions, but also because the band structure is quite insensitive to the particulars of the crystal potential function. (auth)

32920 ANOMALOUS HYPERFINE FIELD AT Rh NUCLEUS IN Fe-Rh ALLOY FOLLOWING LOW ENERGY COULOMB EXCITATION. Keszthelyi, L.; Demeter, I.; Pocs, L.; Szokefalvi-Nagy, Z.; Varga, L. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 28: 91-101(1970).

The values of the rotation angles for the 298-keV and 360-keV states of ^{103}Rh measured after Coulomb excitation with 2.5-MeV protons in $Fe_{51.5}Rh_{48.5}$ alloy are interpreted by considering the existence of a transient field at such low energies. (auth)

32921 g-FACTOR OF THE 364 keV STATE OF ^{184}W AND THE HYPERFINE FIELDS OF TUNGSTEN IN IRON, COBALT, AND NICKEL. Gerdau, E.; Mueller, W. K.; Wolf, H. J. (Univ., Hamburg). Z. Phys.; 235: 124-9(1970). (In German).

The g-factor of the 364-keV state of ^{184}W was measured by the time integral angular correlation method using the high hyperfine fields at the tungsten nucleus in iron. The same experiment was performed with the 111-keV state giving the ratio g(364 keV)/g(111 keV) = 1.02(14). Using this ratio, g(364 keV-level) = 0.286(35) was deduced. For the hyperfine fields of W in Fe, Co, and Ni at 300°K, -610(35) kG, -358(23)kG and -80(3)kG respectively were determined. (auth)

32922 MAGNETIC SUSCEPTIBILITY OF URANIUM CARBONITRIDE. Ohmichi, Toshihiko; Nasu, Shoichi (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 7: 268-70(May 1970).

$UC_{1-x}N_x$ solid solutions are mixtures of antiferromagnetic and paramagnetic compounds. The susceptibility of such mixtures with $1.0 \geq x \geq 0.4$ was measured between 4 and 300°K. The mixtures were found to be antiferromagnetic up to x = 0.5 with Néel temperatures in the range 40 to 52°K; the susceptibility peak diminishes until at $UC_{0.6}N_{0.4}$, it completely disappears. The Curie constant decreases smoothly with increasing carbon content, and an interpretation of this behavior is given. The unusually large temperature-independent term χ_0 is pointed out. (D.L.C.)

32923 KNIGHT SHIFT IN CADMIUM AND CADMIUM-MERCURY ALLOYS. Williams, D. Llewelyn; Sharma, S. N. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 48: 1416-18(1 Jun 1970).

Additional Knight shift measurements on cadmium are presented which eliminate the possibility of an anomaly in the neighborhood of 150°K. Results on a $Cd_{88}Hg_{12}$ single crystal are interpreted in terms of the smearing of the periodicity of the pseudopotential as a result of alloying. (auth)

32924 LOW-TEMPERATURE ELECTRICAL RESISTIVITY AND MAGNETIC SUSCEPTIBILITY OF DILUTE Mg-Ce ALLOYS. Hedgcock, F. T.; Petrie, B. (McGill Univ., Montreal). Can. J. Phys.; 48: 1283-7(1 Jun 1970).

The electrical resistivity of a series of magnesium alloys containing from 300 to 1041 parts per million of gadolinium was measured from 4.2°K to room temperature. No low-temperature anomalies were observed, and it was found that Matthiessen's rule was obeyed extremely well over the whole temperature range studied. The electrical resistivity and magnetic susceptibility measurements indicate that the cerium ion in magnesium is in a triply ionized state, and that the contribution to the resistivity can be almost totally accounted for by assuming normal potential impurity scattering. This suggests that the *f* level of cerium in magnesium lies well below the Fermi level of magnesium and that there is very little *s-f* mixing between the *f* level of cerium of the conduction electron states of magnesium. (auth)

32925 EFFECT OF MAGNETIC BREAKDOWN AND NONLINEAR MAGNETIZATION ON THE HIGH-FIELD MAGNETORESISTANCE OF Be. Reed, W. A.; Condon, J. H. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., B; 1: 3504-10 (15 Apr 1970).

The high-field magnetoresistance of Be exhibits large-amplitude quantum oscillations as a function of magnetic field for the field parallel to the hexagonal axis. A low frequency, which appears only at temperatures below 4.2°K, cannot be related to a Fermi-surface area. It is demonstrated how this frequency is generated through the interaction of magnetic breakdown and the magnetic domains reported by Condon. (auth)

32926 MAGNETIC INTERACTIONS IN RARE EARTH BORIDES. Fisk, Zachary. San Diego, Calif.; Univ. of California (1969). 96p.

Thesis.

Rare earth hexa-, dodeca-, and secondarily, tetraborides were studied, utilizing experimental data on magnetic susceptibility, electric resistivity, and depression of the superconducting transition temperatures of YB_6 and ZrB_{12} by rare earth impurities. Ce, Tm, and Yb impurities in YB_6 are found to depress the superconducting transition temperature more strongly than expected. Apart from these exceptions, the conduction electron-f-electron interaction appears normal and is of sufficient strength to account for the magnetic interactions in GdB_6, TbB_6, and DyB_6. A speculative argument is given to explain the Néel temperatures of these three compounds. In connection with this discussion, magnetic susceptibility and spin-disorder resistivity data are presented for the heavy rare earth tetraborides. For these compounds the spin-disorder resistivity varies as expected, but the Néel temperatures follow a peculiar pattern. YB_6 with Ce impurities and CeB_6 were found to have large resistance minima reminiscent of Kondo anomalies. These are discussed in terms of virtual 4f levels. Magnetic susceptibility data on CeB_6 and the dilute Ce in YB_6 alloy are partially explained by crystal field considerations. Dilute Ce in semiconducting SrB_6 shows a smaller crystal field splitting than in metallic YB_6, contrary to what might be expected for static Stark fields. A similar situation is observed for Pr impurities in SrB_6 and YB_6. The semiconductivity and ferromagnetism of EuB_6 versus the metallic conductivity and antiferromagnetism of the

other rare earth hexaborides are shown to follow naturally from ideas due to Bloembergen and Rowland. The depression of the superconducting transition temperature of ZrB_{12} by rare earth impurities is found to be completely anomalous. Pr impurities have an enormous effect, analogous to Ce in YB_6. An electrical resistance minimum is found in ZrB_{12} alloys containing Pr. In addition, Tm and Yb impurities are particularly interesting. Although the evidence is not conclusive, it is suggested that Yb exists in a virtual bound 4f-hole configuration in ZrB_{12}. Yb impurities in ScB_{12} produce an enormous resistance minimum. YbB_{12} itself, although not obtained in pure form, appears to be the f-hole counterpart to CeB_6. (Diss. Abstr. Int., B)

32927 A STUDY OF THE MAGNETORESISTANCE AND THE HALL RESISTIVITY OF CADMIUM AND CADMIUM–ZINC CRYSTALS. Katyal, Om Parkash. Lafayette, Ind.; Purdue Univ. (1969). 68p.

Thesis.

Measurements of the magnetoresistance and the Hall resistivity of cadmium and cadmium–zinc crystals in the residual resistance ratio range of 40,000 to 240 corresponding to a maximum zinc concentration of 1.5 at.%, are reported in the temperature ranges of 1.4 to 4.2°K, 9 to 20°K, and at 77°K for magnetic fields below 25 kgauss. The Hall resistivity is positive for values $\omega\tau < 1$, but below 20°K and for $\omega\tau > 1$ it can be positive or negative, depending on temperature and impurity concentration. The results indicate that the concept of a single static electron scattering time has to be abandoned in the case of reduced phonon scattering. The similarity between the effects of impurity and pressure on the Hall resistivity are indicated to be compatible with the concept of intersheet scattering. In the angular dependence of the transverse magnetoresistance of cadmium and cadmium–zinc crystals, it is observed that with the increase of temperature the magnetoresistance for H||[0001] decreases more rapidly than for other directions of H. The results agree with the earlier developed semiquantitative calculations by Young and they seem to be compatible with the concept of intersheet scattering. Preliminary results of measurements on the longitudinal magnetoresistance ($\vec{J}||\vec{H}||[0001]$) of cadmium and cadmium–zinc crystals in the temperature range 1.4 to 4.2°K show that the resistance starts increasing linearly with magnetic field beyond a region of saturation magnetoresistance. (Diss. Abstr. Int., B)

32928 VOLATILIZATION AND FORMATION OF DISLOCATION LOOPS IN BERYLLIUM OXIDE DURING ELECTRON-MICROSCOPY STUDY. Cordier, Alain; Degeilh, Andre (Centre National de la Recherche Scientifique, Toulouse). J. Microscop.; 9: 27-42(Jan 1970). (In French).

The volatilization process of BeO and the formation of dislocation loops are explained by the presence of an intense electric field within the crystal. The secondary emission phenomenon and the high resistivity of BeO induce such a field. The nature of the cleavage faces leads either to the volatilization or to the formation of loops. (auth)

32929 MORPHOLOGY OF RHENIUM METAL DISPERSED ON HIGH AREA OXIDES. Lewis, R. T. (Chevron Research Co., Richland, Calif.). J. Appl. Phys.; 41: 2961-3(Jun 1970).

Measurements are presented and discussed of magnetic susceptibility, made at temperatures below the superconducting transition of rhenium, on samples made by dispersing rhenium in porous high area oxides by typical catalyst preparative techniques. These measurements show that a significant fraction of the rhenium in these samples is in the form of extensive networks, probably consisting of thin films, which are continuous over distances of the order of 25 μ or more. (auth)

32930 PHOTOELECTRONIC PROPERTIES OF ION-IMPLANTED CdS. Hou, S. L.; Marley, J. A. Jr. (Corning Glass Works, N. Y.). Appl. Phys. Lett.; 16: 467-9(1 Jun 1970).

The photoelectronic properties of CdS successively implanted with 1.0-, 0.5-, and 0.3-MeV P^+ ions versus annealing cycles were studied. Diodes thus formed were highly photosensitive, with photoconductive gains between 10^2 and 10^4. Yellow electroluminescence was observed at 77°K. Short annealing creates centers with a sheet-resistance thermal activation energy of 0.13 eV. Prolonged annealing creates states 0.75 to 0.08 eV below the band edge. (auth)

Moessbauer Effects and NMR

Refer also to abstract 32629.

32931 (ORNL-4526, pp 44-51) ELECTRON SPIN RESONANCE. (Oak Ridge National Lab., Tenn.).

LUNAR MATERIALS — spectra of rocks and fines, EPR and NMR

MAGNESIUM SILICATES — manganese ion EPR spectrum in forsterite

MANGANESE IONS — electron paramagnetic resonance spectrum in forsterite (D.L.C.)

32932 ON THE MAGNETIC HYPERFINE FIELD AT ^{182}W RECOIL IMPLANTED INTO IRON. Hagemann, K. A.; Kiss, D.; Ogaza, S. (Univ. of Copenhagen). Acta Phys. Acad. Sci. Hung.; 28: 185-9(1970).

The perturbed angular distributions of gamma rays de-exciting the 2^+ and 4^+ states of ^{182}W, recoil-implanted into iron after Coulomb excitation, were measured. A satisfactory fit of the rotation patterns were obtained under the assumption of a static magnetic interaction, in contradiction to a previous measurement. The internal magnetic field acting on recoiled ^{182}W was determined to be -555 ± 75 kG, in fairly good agreement with Moessbauer experiments. A value for the transient field, which is in agreement with that for the nearby Pt nucleus and with theoretical calculations, was found. (auth)

32933 COLD FACTS ABOUT MOESSBAUER MEASUREMENTS. Katila, T. E.; Stenholm, S. (Technical Univ. of Helsinki, Otaniemi, Finland). Arkhimedes; No. 2, 28-50(1969). (In Finnish).

The field of Moessbauer experiments at low temperatures is reviewed. The discussion is illustrated with measurements down to 0.03°K performed using a $^3He/^4He$ dilution refrigerator. The basic results of the theory of recoilless γ emission and absorption are presented. The hyperfine interactions between the nucleus and its surroundings determine the nuclear energy levels, and these may be deduced from the measured Moessbauer spectra. The magnetic hyperfine splitting is discussed in some detail and typical spectra for ^{57}Fe are shown. The electric quadrupole splitting is considered, and measurements on ^{193}Ir are included. At sufficiently low temperatures, the nuclear energy levels become unequally populated, the population ratios being given by the appropriate Boltzmann factors. These effects are seen in the measured spectra. Both the case with the emitter and the case with the absorber at low temperatures are discussed. The polarization has been used to determine the transition matrix elements of forbidden β decay. It is pointed out the Moessbauer effect can serve as a primary thermometer for calibrating other thermometers at very low temperatures. The effects of the atomic environment are transmitted to the nuclear spin through the s-electron density at the site of the nucleus (in the nonrelativistic approximation). When the electronic state of the atom fluctuates due to relaxation, the Moessbauer effect can measure a time average of the fluctuating field only. The slowing down of the relaxation rate at low temperatures is seen in Moessbauer spectra. It is pointed out that when magnetic ordering takes place, this can be seen in Moessbauer spectra only when the relaxation is fast. As an example, the magnetization in $EuSO_4$ is shown, giving a transition temperature of 430 mdeg. K. (auth)

32934 MEASUREMENT OF THE MOESSBAUER EFFECT IN ^{61}Ni. Ambe, F.; Ambe, S.; Takeda, M.; Wei, H. H.; Ohki, K.; Saito, N. (Inst. of Physical and Chemical Research, Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 92-4(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A procedure was developed to separate radiochemically the ^{61}Cu produced by the $^{58}Ni(\alpha,p)^{61}Cu$ and $^{58}Ni(\alpha,n)$ reactions and to prepare a Cu–^{61}Cu source within several hours. This procedure is described briefly and the Moessbauer spectra of two absorbers, nickel metal and nickel oxide, are shown. (L.M.T.)

32935 ISOTOPIC SUBSTITUTION FOR OBSERVING LINEAR ELECTRIC FIELD EFFECTS. Usmani, Zahiruddin; Reichert, Jonathan F. (Case Western Reserve Univ., Cleveland). Phys. Rev. Lett.; 24: 709-10(30 Mar 1970).

Isotopic substitution of ^6Li made it possible to measure the electric field perturbation of the ENDOR hyperfine interaction of F centers in lithium fluoride. (auth)

32936 MOESSBAUER EFFECT OBSERVATIONS OF RECOIL RADIATION DAMAGE FOLLOWING COULOMB EXCITATION IN VARIOUS Hf COMPOUNDS. Jacobs, Clarence Gilbert Jr. Iowa City, Iowa; Univ. of Iowa (1969). 174p.

Thesis.

Moessbauer effect experiments following Coulomb excitation were performed, involving Hf nuclei located in Hf metal, HfB_2, HfC, HfN, and HfO_2. The first excited states of ^{178}Hf, ^{180}Hf, ^{176}Hf, and ^{177}Hf were populated via Coulomb excitation by 6-MeV alpha particles. The majority of the experiments were performed with

both targets and absorbers near liquid nitrogen temperature. Anomalous hyperfine interactions were found in all of the compounds when they are used as targets, compared to the hyperfine interactions observed when they are used as absorbers. These anomalies are attributed to recoil radiation damage associated with the recoil of the Moessbauer nuclei following Coulomb excitation. All anomalous hyperfine interactions produce Moessbauer spectra which can be associated with electric quadrupole interactions in the target. The hyperfine interactions observed in the absorbers are generally consistent with those reported in the literature. The anomalous interactions are interpreted in terms of lattice distortions resulting from vacancies produced in the locale of the decaying recoil nuclei. The degree of lattice distortion is found to be dependent upon the bonding characteristics of the compounds. (Diss. Abstr. Int., B)

32937 MEASUREMENT OF NUCLEAR SPIN RELAXATION TIMES ON AN HA-100 SPECTROMETER. Sykes, Brian D.; Wright, John M. (Harvard Univ., Cambridge, Mass.). Rev. Sci. Instrum.; 41: 876-7(Jun 1970).

The modification of a Varian HA-100 spectrometer to enable $T_1\rho(H_1)$ to be measured while the spectrometer is locked on another resonance in the sample is described. (W.H.K.)

32938 MOESSBAUER STUDY OF HYPERFINE INTERACTIONS IN DIVALENT EUROPIUM COMPOUNDS AT ULTRA LOW TEMPERATURES. Ehnholm, G. J. (Technical Univ. of Helsinki, Otaniemi, Finland); Katila, T. E.; Lounasmaa, O. V.; Reivari, P.; Kalvius, G. M.; Shenoy, G. K. Z. Phys.; 235: 289-307(1970).

The Moessbauer resonance of the 21.6-keV transition in ^{151}Eu was used to investigate the magnetic properties of divalent ionic europium compounds at ultra-low temperatures. The specimens were cooled by a $^3He/^4He$ dilution refrigerator to a minimum temperature of 0.04°K. The following magnetic-ordering temperatures were found: $EuSO_4$, 0.43°K; EuF_2, 1.0°K; $EuCO_3$, 1.05°K; $EuCl_2$, 1.1°K; EuC_2O_4, 1.9°K; $EuC_2O_4 \cdot H_2O$, 2.8°K. The absolute value of the saturation hyperfine field H_{eff} of all these compounds is between 315 and 337 kOe. The temperature dependence of H_{eff} deviates somewhat from a $S = \frac{1}{2}$ Brillouin function. This behavior is probably due to relaxation phenomena. (auth)

32939 ELECTRON-NUCLEAR DOUBLE-RESONANCE-ENHANCED DEUTERON MAGNETIC RESONANCE. McCalley, Roderick C.; Kwiram, Alvin L. (Harvard Univ., Cambridge, Mass.). Phys. Rev. Lett.; 24: 1279-81(8 Jun 1970).

The electron-nuclear double-resonance method is used to obtain greatly enhanced NMR signals from the distant nuclei in molecular crystals that have been x irradiated to produce paramagnetic centers. Reduction of the ESR by over 98% is observed for protons in malonic acid, and the deuteron and carbon-13 NMR were also studied in the perdeuterated crystals. Deuteron $\Delta m = 2$ transitions were readily detected, as well as the $\Delta m = 1$ signals in crystals with only 1% D/H isotopic ratio. (auth)

Theory

32940 TRANSPORT IN A MAGNETIC FIELD. III. APPLICATION TO SPIN WAVES IN ALKALI METALS. Van Zandt, L. L. (Purdue Univ., Lafayette, Ind.). Phys. Rev., B; 1: 3235-40(15 Apr 1970).

The transport equation derived in the preceding paper is compared to Silin's and applied to the problem of interpreting the spin-wave spectrum of weakly magnetized sodium. Several schemes for parametrizing the conduction-electron interactions are considered; it is shown that the experiments do not yet favor any particular scheme, and that therefore the nature of the interactions is still undetermined. An uncertainty-principle argument is offered to suggest that both transport equations are of suspect validity in the range of frequencies and wavelengths so far experimentally explored. (auth)

Theoretical Physics

32941 ON THE PARTICLE DENSITY OF MASS ZERO BOSONS AND ENERGY DENSITY OF MASS ZERO FERMIONS. Rashid, Khalid (Univ., Marburg, Ger.). Z. Phys.; 235: 181-90(1970).

It is shown that even nonlocal generalizations of the usual expressions for (a) the particle probability density of mass zero, spin zero (one) bosons and (b) the energy density of mass-zero, spin-one-half fermions can become negative, indicating that the method of Gerlach et al., for obtaining positive definite expressions for massive particles for the above quantities does not work here. (auth)

32942 DEMONSTRATION OF THE SPECTRAL DECOMPOSITION PRINCIPLE. Andrade e Silva, Joao (Institut de France, Paris). Compt. Rend., Ser. B; 270: 565-8(2 Mar 1970). (In French).

It is shown that in causal theory the probabilities of the possible results of measurements carried out on a particle are deduced from the distribution of the probabilities of finding the particle on its wave. (France)

32943 THREE-DIMENSIONAL LINEAR TRANSPORT THEORY. Case, K. M. (Rockefeller Univ., New York); Hazeltine, R. D. J. Math. Phys. (N. Y.); 11: 1126-35(Apr 1970).

A recent technique for extending the singular eigenfunction method in linear transport theory to problems which are not strictly 1-dimensional is compared to a more naive approach based on the Fourier transform. The latter appears to have advantages with regard to simplicity and directness. (auth)

32944 GENERALIZED PERTURBATION THEORY FOR QUANTUM OSCILLATORS. Webber, J. C. (Sir George Williams Univ., Montreal); Paul R. Can. J. Phys.; 48: 1418-20(1 Jun 1970).

The time dependence of the quantum statistical density operator for oscillator systems (open or closed) is formulated within a generalized time-dependent perturbation theory. The new and more convergent perturbation series is also applicable to any boson system in nonequilibrium. (auth)

32945 COMPUTATION OF MAGNETIC FIELDS WITHIN THREE-DIMENSIONAL HIGHLY NONLINEAR MEDIA. Holzinger, Carl S. (Lehigh Univ., Bethlehem, Pa.). IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-6: 60-5(Mar 1970).

A technique is presented for the computation of magnetic fields in three-dimensional multicomponent systems containing highly nonlinear materials when under the influence of current-carrying conductors. The materials must be nonhysteretic. The technique is based upon the utilization of a computer to solve: $H = H_0 - \int (\nabla' \cdot M'/r^2)\, r^0\, d\tau' + \int (n' \cdot M'/r^2)\, r^0\, dS'$. The computations yield such things as the internal distribution of M, the external H fields, the forces between various magnetic components, and the forces between any magnetic component and the current-carrying conductors. An application to a system consisting of a superconducting solenoid and a yoke for field shaping and shielding is discussed. (auth)

32946 BATTELLE RENCONTRES. 1967 Lectures in Mathematics and Physics. DeWitt, Cecile M.; Wheeler, John A. (eds.). New York; W. A. Benjamin, Inc. (1968). 570p.

The book contained 20 lectures. Separate abstracts were prepared for 13 lectures. Other lectures included commutativity of the algebra of invariant differential operators on a symmetric space, hyperbolic partial differential equations on a manifold, topology and differential geometry, continuous solutions of linear equations, and characterization of stable mappings. (J.F.P.)

For abstracts of individual sections see: 32604, 32947, 33030, 33031, 33041, 33042, 33048–33052, 33061, and 33062.

32947 EVERETT–WHEELER INTERPRETATION OF QUANTUM MECHANICS. DeWitt, Bryce S. (Univ. of North Carolina, Chapel Hill). pp 318-32 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

The Everett–Wheeler interpretation of quantum mechanics is discussed in ordinary nonrelativistic quantum mechanics. This discussion includes the proof of the metatheorem that the mathematical formalism of the quantum theory is capable of yielding its own interpretation. It is noted and proven that there is no experiment that can reveal the existence of the other worlds in a certain superposition. The formalism is applied to one of the memory sequences in a given state vector. (J.F.P.)

32948 NODAL STRUCTURE OF SCHROEDINGER WAVE FUNCTIONS AND ITS PHYSICAL SIGNIFICANCE. Riess, J. (Univ. of British Columbia, Vancouver). Ann. Phys. (N. Y.); 57: 301-21(Apr 1970).

The nodes of Schroedinger wave functions of an N-particle system are investigated. It is found that the phase of the wave function depends in a critical way on the $(3N - 2)$-dimensional nodal manifolds and their circulation numbers. In terms of these nodal structures one obtains (a) a necessary condition for the occurrence of a persistent particle current, (b) a necessary and sufficient condition for the so-called paramagnetic part of the energy to vanish under a (generalized) gauge transformation, (c) a necessary condition for the occurrence of orbital paramag-

netism and strong orbital diamagnetism, and (d) an explanation of induced orbital paramagnetism. (auth)

32949 ROTATIONAL STATES OF TWO-PARTICLES SYSTEM. Gal, E. V. Yadern. Fiz.; 11: 334-41(Feb 1970). (In Russian).

Rules of separation of rotational states of two-particles system with central interaction are studied in classical and quantum mechanics. It is shown that pure rotation of the system corresponds to the tight binding of particles, i.e., to rejection of one degree of freedom. Possible existence of zero-energy rotations of the system is discussed. Sufficient conditions for separation of rotational states are obtained for which the spectrum does not coincide with that of hard rotator. (auth)

32950 CHERENKOV–VAVILOV EFFECT FOR PARTICLES WITH SPINS IN GYROTROPIC CRYSTALS. Bolsun, A. I.; Vlasov, R. A.; Gronskii, V. K.; Fedorov, F. I. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 78-82 (1969). (In Russian).

The quantum theory of Vavilov–Cherenkov effects was determined for particles with spins (including the high spins 1 and $^3/_2$) in gyrotropic crystals of arbitrary symmetry. The invariant concept, combining non-coordinate methods in the optics of anisotropic media, was used for evaluating gyrotropic and anisotropic influences, and the method of projection operators was used for calculating matrix elements. (R.V.J.)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 32978.

32951 (PITHA-36) SEARCH FOR FRACTIONALLY CHARGED PARTICLES IN SHOWERS. Faissner, H.; Holder, M.; Krisor, K.; Mason, G.; Sawaf, Z.; Umbach, H. (Technische Hochschule, Aachen (West Germany). Physikalisches Institut (III)). 1970. 13p. Dep. CFSTI (U. S. Sales Only).

A search was made for relativistic quarks of charge e/3 in cosmic ray showers at sea level. A hodoscope of wire proportional counters was used, which was capable of measuring the location and specific ionization of several particles arriving simultaneously. An upper limit for the flux of quarks observed singly in the apparatus was established, with 90% confidence, at 1.9×10^{-10} sec^{-1} cm^{-2} sr^{-1}. Corresponding limits were set for quarks with one and two accompanying particles at, respectively, 6.5×10^{-10} sec^{-1} cm^{-2} sr^{-1} and 2.2×10^{-9} sec^{-1} cm^{-2} sr^{-1}. (auth)

32952 SEARCH FOR FRACTIONALLY CHARGED PARTICLES IN SHOWERS OF LOW DENSITY. Faissner, H.; Holder, M.; Krisor, K.; Mason, G.; Sawaf, Z.; Umbach, H. (Technische Hochschule, Aachen). Phys. Rev. Lett.; 24: 1357-60(15 Jun 1970).

A search was made for relativistic quarks of charge e/3 in cosmic-ray showers at sea level. A hodoscope of wire proportional counters was used, which was capable of measuring location and specific ionization of several particles arriving simultaneously. An upper limit for the flux of quarks observed singly in the apparatus was established, with 90% confidence, at 1.9×10^{-9} sec^{-1} cm^{-2} sr^{-1}. Corresponding limits were set for quarks with one and two accompanying particles at, respectively, 6.5×10^{-10} sec^{-1} cm^{-2} sr^{-1} and 2.2×10^{-9} sec^{-1} cm^{-2} sr^{-1}. (auth)

Electromagnetic

Refer also to abstract 33119.

32953 (DESY-70/19) RHO PRODUCTION WITH LINEARLY POLARIZED PHOTONS. Criegee, L.; Franke, G.; Loeffler, G.; Schueler, K. P.; Timm, U.; Zimmermann, W.; Werner, H.; Dougan, P. W. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1970. 13p. Dep. CFSTI (U. S. Sales Only).

The process $\gamma p \rightarrow \rho^0 p \rightarrow \pi^+\pi^- p$ was studied with linearly polarized photons between 1.4 and 3.3 GeV. Almost pure diffraction like behavior is observed in the whole energy region. (auth)

32954 SCATTERING OF FAST MUONS BY COPPER NUCLEI. Bhattacharyya, D. P. (Presidency Coll., Calcutta). Z. Phys.; 233: 445-51(1970).

Scattering of fast muons by copper nuclei was studied by a cloud chamber containing five copper plates of thickness 10.7 g/cm^2 each operated by coincidence and anticoincidence technique in the momentum range 1.70 ± 0.05 BeV/c. Muons of scattering angles up to 5.5° (elastic momentum transfer ~170 MeV/c) were observed, and 4,002 scattering distribution was close to the theoretical distribution of Cooper and Rainwater for electromagnetic interaction between the muon and the finite nucleus. No significant anomaly in scattering angles was detected. (auth)

32955 A COMPARISON OF ELECTRON-PROTON AND POSITRON-PROTON ELASTIC SCATTERING AT FOUR-MOMENTUM TRANSFERS UP TO 5.0 (GeV/c)^2. Mar, Jerry. Pasadena, Calif.; California Inst. of Tech. (1969). 223p.

Thesis.

A comparison of elastic electron-proton and positron-proton scattering was made at eight different values of four-momentum transfer squared, ranging from 0.20 to 5.0 (GeV/c)^2. The object of the comparison is to determine whether the ratio (R) of the radiatively corrected positron-proton cross section to the electron-proton cross section differs measurably from 1. An $R \neq 1$ result can be interpreted as being due to the two-photon exchange contribution, since the interference between the first order scattering amplitude and the two-photon exchange amplitude occurs with opposite signs for electrons and positrons. The data were obtained using positron and electron beams from the Stanford Linear Accelerator at two energies. Comparisons were made at 4 GeV for scattering angles of 12.5, 20.0, 27.5, and 35.0 degrees, and at 10 GeV for 2.6, 5.0, 12.5, and 15.0 degrees. The incident beam was passed through a liquid hydrogen target and the scattered electrons detected in either the SLAC 8-GeV/c or 20-GeV/c magnetic spectrometers. The accuracy to which R was determined ranged from ±1.6% for the measurement at 4 GeV, 12.5° to ±10.8% at 4 GeV, 35°. The measurements, after radiative corrections, are consistent with R = 1 within one standard error. Limits for the size of the two-photon amplitude and the consequences of these limits on theoretical two-photon estimates, are given. (Diss. Abstr. Int., B)

32956 STUDY OF $\gamma p \rightarrow p\omega$ WITH LINEARLY POLARIZED PHOTONS AT 2.8 AND 4.7 GeV. Ballam, J. (Stanford Linear Accelerator Center, Calif.); Chadwick, G. B.; Gearhart, R.; (and others). Phys. Rev. Lett.; 24: 1364-8(15 Jun 1970).

The reaction $\gamma p \rightarrow p\omega$ was studied in a hydrogen bubble chamber using a linearly polarized photon beam. The total cross section was found to be 5.8 ± 0.5 μb at 2.8 GeV and 3.2 ± 0.3 μb at 4.7 GeV. From the decay angular distributions these cross sections were separated into contributions from natural- and unnatural-parity exchange σ^N, σ^U in the t channel. For $|t| < 1$ GeV^2 $\sigma^N = 2.5 \pm 0.4$ μb, $\sigma^U = 2.7 \pm 0.4$ μb at 2.8 GeV and $\sigma^N = 1.8 \pm 0.3$ μb, $\sigma^U = 1.3 \pm 0.3$ μb at 4.7 GeV. The contributions from unnatural-parity exchange are consistent with the predictions of the one-pion-exchange model. (auth)

32957 SEARCH FOR VIOLATION OF TIME-REVERSAL INVARIANCE IN INELASTIC e-p SCATTERING. Appel, J. A.; Chen, J. R.; Sanderson, J.; (and others) (Harvard Univ., Cambridge, Mass.). Phys. Rev., D; 1: 1285-1303(1 Mar 1970).

Electrons were scattered inelastically from a hydrocarbon target containing protons polarized normal to the scattering plane. Scattered electrons with energies corresponding to the production of the Δ(1236), N(1512), and N(1688) pion-nucleon resonances were observed. A search was made for changes in the cross section as the target polarization was reversed. Any changes would have been evidence of a violation of time-reversal invariance in the electromagnetic interactions of the hadrons. No such changes were observed. With the maximum time-reversal-violating effect possible, the asymmetry would be 10 times the upper limit of this experiment. Early attempts at a coincidence-polarization experiment are described in an appendix. (auth)

32958 $\pi^+\pi^-\pi^0$ DECAY OF 1138 η MESONS PRODUCED IN $K^-p \rightarrow \Lambda\eta$ NEAR THRESHOLD. Carpenter, D. W.; Binkley, M. E.; Chapman, J. W.; (and others) (Duke Univ., Durham, N. C.). Phys. Rev., D; 1: 1303-7(1 Mar 1970).

The Dalitz plot density of $\eta \rightarrow \pi^+\pi^-\pi^0$ is examined. The asymmetry on the $\pi^\pm$ energies is found to be $A = (N^+ - N^-)/(N^+ + N^-) = -0.014 \pm 0.030$, where $N^\pm$ is the number of events for which $T_\pm > T_\mp$. The density is well fitted with a linear dependence on T_0: $|M|^2 \propto 1 + 2\alpha[(3T_0/Q) - 1]$, with $\alpha = -0.47 \pm 0.04$. (auth)

32959 SEARCH FOR NEW VECTOR BOSONS AND A TEST OF QUANTUM ELECTRODYNAMICS. Hayes, S.; Imlay, R.; Joseph, P. M.; Keizer, A. S.; Knowles, J.; Stein, P. C. (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett.; 24: 1369-72(15 Jun 1970).

Muon pairs with invariant pair mass $M_{\mu\mu}$ between 1300 and 2100 MeV have been photoproduced from carbon. No evidence is found for a heavy vector boson decaying into muon pairs in this mass region, and upper limits on its production are given. Limits on a possible breakdown of quantum electrodynamics are also obtained. Assuming a breakdown in the cross section proportional to $M_{\mu\mu}^4$, an upper limit is obtained on the breakdown parameter λ of $|\lambda| < 0.035$ GeV^{-4}, with a confidence level of 95%. (auth)

Weak

32960 ANALYSIS OF 17 898 τ^+ DECAYS AT REST. Grauman, J. (Stevens Inst. of Tech., Hoboken, N. J.); Koller, E. L.; Taylor, S.; Pandoulas, D.; Hoffmaster, S.; Raths, O.; Romano, L.; Stamer, P.; Kanofsky, A.; Mainkar, V. Phys. Rev., D; 1: 1277-84(1 Mar 1970).

The energy spectrum of the decay pions in τ^+ decay was obtained from a sample of 17 898 events. It is found that the spectrum is adequately fitted by a squared matrix element of linear form, $|M|^2 \propto 1 + \alpha_\tau \times (M_K Q/m_\pi^2)Y$, with $\alpha_\tau = 0.131 \pm 0.008$. No evidence for CP noninvariance is found for $\tau^\pm$ decays. A significant violation of the $\Delta I = \frac{1}{2}$ rule is observed for $K^+ \rightarrow 3\pi$ decays. Comparison with several theoretical models for $K \rightarrow 3\pi$ decays shows fair agreement between experiment and theory. (auth)

Strong (Baryon-Induced)

32961 (IFVE-SEF-69-79) FORMATION OF ANTIDEUTERONS BY PROTONS WITH ENERGY UP TO 70 GeV. Binon, F.; Vishnevski, N. K.; Duteil, P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1969. 12p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The yield of antideuterons generated by protons with energy 43, 52, and 70 GeV on aluminum nuclei, was measured. A relative antideuteron yield increases with momentum decrease and with the increase of the emission angle. (auth)

32962 (IS-T-358) ANTIPROTON–PROTON ANNIHILATION INTO FOUR AND FIVE PIONS AT 2.4 AND 2.9 GeV/c. Radlinski, Ronald Paul (Ames Lab., Iowa). Feb 1970. Contract W-7405-eng-82. 94p. Dep. CFSTI.

Thesis.

From a sample of 16,000 four-pronged events from $\bar{p}p$ interactions at 2.4 GeV/c and 9,400 at 2.9 GeV/c, a study of resonance production and angular distributions was made for the constrained reactions $\bar{p}p \rightarrow 2\pi^+ 2\pi^- (\pi^0)$. A limited analysis of the unconstrained reactions $\bar{p}p \rightarrow 2\pi^+ 2\pi^- n\pi^0$ (n > 1) is also presented. The reaction cross sections and resonance cross sections were found to be higher at 2.4 GeV/c than at 2.9 GeV/c. The four pion final state was found to proceed mainly through the $\rho^0\pi^+\pi^-$ and $f^0\pi^+\pi^-$ intermediate states. The five pion final state was produced via three mesons ($\rho^\pm \rho^0 \pi^\pm \rho^0 \rho^0 \pi^0$, A π π) with frequencies of 0.42 ± 0.10 at 2.4 GeV/c and 0.29 ± 0.06 at 2.9 GeV/c. At each momentum, the $\rho^\pm\pi^+\pi^+\pi^-$ intermediate state occurred in about 20% of the five pion reactions. Evidence for a $f^0\pi$ resonance of mass 1700 MeV/c^2 in the four pion channel and for B meson production in the five pion channel was found at 2.4 GeV/c. In the center-of-mass system, the tendency for the $\pi^-(\pi^+)$ to be produced in the direction of the antiproton (proton) decreased with increased multiplicity and increased at the higher momentum. The deviations of the distributions of the center-of-mass angle between pairs of pions from Lorentz phase space predictions were, in general, smaller at 2.9 GeV/c than at 2.4 GeV/c. The production and decay angular distributions of resonance particles were also investigated. (auth)

32963 MEASUREMENT OF THE DECAY ASYMMETRY OF THE LEPTONS WITH RESPECT TO SIGMA POLARIZATION IN THE REACTION $\Sigma^- \rightarrow n + l^- + \bar{\nu}_l$. Bogert, Virgil Dixon. New Haven; Yale Univ. (1969). 186p.

Thesis.

The leptonic decay modes of the Σ^- hyperon $E^- \rightarrow n + e^- + \bar{\nu}_e$ and $\Sigma^- \rightarrow n + \mu^- + \bar{\nu}_\mu$ were studied using polarized Σ^- produced by the reaction: $k^- + p \rightarrow \Sigma^- + \pi^+$ in the vicinity of the $Y_0^*(1520)$ resonance. Approximately 125,000 Σ^- events were scanned; after suitable fiducial volume restrictions and other geometric cuts approximately 95,000 measured Σ^- events remained in the sample. Events for which the measured momentum of the decay track was not consistent with the usual two body decay were reexamined, and those which were determined to be possible leptonic candidates were bubble counted. Mass assignments based upon the measured $\beta_{lepton}^2/\beta_{\pi}^2$ ratio were made and yielded a raw sample of 52 e^- and 37 μ^-. Additional cuts to assure the elimination of any contamination from the π^- radiative decay mode reduced the leptonic sample to 37 e^- and 13 μ^-. The decay parameter $\alpha_{lepton}(g_a/g_v)$ was measured, yielding $\alpha = -0.14 \pm 0.56$ for the sample of 37 e^-, and $\alpha = +0.40 \pm 0.56$ for the full sample of 50 leptons. This measurement was not adequate to make an unambiguous choice between the two predicted values for α_{lepton} based upon the theory of Cabibbo, namely $\alpha_{lepton} = -2/3$ or $+1/3$. (Diss. Abstr.)

32964 ON THE HYPERNUCLEI RESONANT STATES $^6_\Lambda$Li, $^5_\Lambda$He, AND $^9_\Lambda$Be. Rao, N. K. (Tata Inst. of Fundamental Research, Bombay); Swami, M. S.; Gurtu, A.; Singh, M. B. Proc. Indian Acad. Sci., Sect. A, 71: 32-41(Jan 1970).

An attempt was made to detect narrow resonant states of $^5_\Lambda$He (I = 2), $^6_\Lambda$Li and $^9_\Lambda$Be (I = 1) from among a sample of 128 uniquely identified $^4_\Lambda$H and 195 uniquely identified $^5_\Lambda$He hypernuclei produced by stopping K^-mesons in a nuclear emulsion stack. From the experimental data presented, it is concluded that the production of any of these resonant states is not appreciable; upper limits of 20% and 15% are set for the proportion of $^5_\Lambda$He resulting from the decay of $^6_\Lambda$Li and $^9_\Lambda$Be respectively. (auth)

Strong (Meson-Induced)

Refer also to abstract 32958.

32965 (COO-1428-166) FINAL STATES WITH ONE OR TWO CHARGED PARTICLES AND A VISIBLE $\bar{K}^0$ FROM K^-d INTERACTIONS AT 4.5 GeV/c. Carmony, D. D.; Eisner, R. L.; Ammann, A. C.; Garfinkel, A. F.; Gutay, L. J.; Miller, D. H.; Rangan, L. K.; Yen, W. L. (Purdue Univ., Lafayette, Ind.). Feb 1970. 61p. Dep. CFSTI.

We report on a study of the interactions of 4.48 GeV/c K^- mesons on deuterium. The 372,000 picture exposure was taken in the Argonne National Laboratory 30" deuterium-filled bubble chamber. The $\bar{K}^0$ final states from the one and two prong plus vee topologies are discussed. The final states investigated include: (1) $\bar{K}^0\pi^-pn$; (2) $\bar{K}^0\pi^-d$; (3) $\bar{K}^0\pi^-\pi^0d$; (4) $\bar{K}^0\pi^-p$ (missing mass). Production of the $K^*(890)^-$ resonance is analyzed from both K^- proton and K^- neutron interactions and is compared with absorption and Regge pole models. The production of $\Delta(1236)^-$ in reaction (1) is compared to the predictions of Thews and to those of Maor and Krammer. Strong $K^*(890)^-$ production occurs in reaction (2) and evidence for dominant vector meson exchange is given. The d* enhancement is quite strong in (3) and K^*d^* production is discussed. (auth)

32966 MEASUREMENT OF THE REACTION $\pi^+p \rightarrow K^+\Sigma^+$ AT LARGE MOMENTUM TRANSFERS. Han, K. S. (Univ. of Michigan, Ann Arbor); Akerlof, C. W.; Schmueser, P.; Kirk, P. N.; Rust, D. R.; Ward, C. E. W.; Yovanovitch, D. D.; Pruss, S. M. Phys. Rev. Lett.; 24: 1353-6(15 Jun 1970).

Cross section and polarization in the reaction $\pi^+p \rightarrow K^+\Sigma^+$ were measured at 3, 4, and 5 GeV/c and for momentum transfers up to 3 $(GeV/c)^2$. Beyond the previously investigated forward peak the cross section shows a secondary maximum and a steep decrease towards large momentum transfers. The Σ^+ polarization is large and positive in this region. (auth)

32967 STRUCTURE IN 5-GeV/c π^+p ELASTIC SCATTERING AT LARGE ANGLES. Rust, D. R. (Argonne National Lab., Ill.); Kirk, P. N.; Lundy, R. A.; Ward, C. E. W.; Yovanovitch, D. D.; Pruss, S. M.; Akerlof, C. W.; Han, K. S.; Meyer, D. I.; Schmueser, P. Phys. Rev. Lett.; 24: 1361-4(15 Jun 1970).

Data from a high-resolution experiment on the reaction $\pi^+ + p \rightarrow \pi^+ + p$ at 5 GeV/c show a very deep, sharp dip in $d\sigma/dt$ at $t = -2.8$ $(GeV/c)^2$ and a gentle exponential decrease in $d\sigma/du$ between $u = -1.5$ and -3.5 $(GeV/c)^2$. (auth)

32968 A STUDY OF HYPERNUCLEI PRODUCED BY K^- INTERACTIONS IN A HELIUM BUBBLE CHAMBER. Keyes, Gary Sylvester. Evaston, Ill.; Northwestern Univ. (1969). 193p.

Thesis.

The results of a study of properties of the hypernuclei $^3_\Lambda$H, $^4_\Lambda$H, $^4_\Lambda$He produced by K^- interactions at rest in a helium bubble chamber are presented. The lifetime, binding energy, and production rate of $^3_\Lambda$H are emphasized, and preliminary results are given for the binding energies, production rates, and decay branching ratios of $^4_\Lambda$H and $^4_\Lambda$He. The details of measurements of the Σ^+ mass and an upper limit on the ν_μ mass using the range-energy relation are also included. Existing experimental results on the binding energies, spins, decay modes, and lifetimes for the A = 3 and A = 4 hypernuclei are summarized. The theoretical understanding of the ΛN interaction and analyses of the hypernuclei in terms of an impulse model are also reviewed. (Diss. Abstr. Int., B)

32969 QUASI-THREE-BODY STATES PRODUCED IN π^-p COLLISIONS AT 11.2 GeV/c AND THE DOUBLE REGGE-POLE MODEL. Caso, C. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa); Conte, F.; Tomasini, G.; (and others). Nuovo Cim.; 67A: 613-29(21 Jun 1970).

The reactions $\pi^-p \rightarrow \rho^0\pi^-p$, $\pi^-p \rightarrow f^0\pi^-p$, $\pi^-p \rightarrow \pi^-\pi^-\Delta^{++}$ are studied at 11.2 GeV/c and analyzed in terms of a double Regge-pole model as proposed by Chan, Kajantie and Ranft. The diffractive parameters a, b are determined for several possible exchanged trajectories. The exchange of the Pomeron trajectory, if needed at all, seems to be required by the production of the f^0-particle. (auth)

32970 EXPERIMENTAL STUDY OF K^-p INTERACTIONS BETWEEN 450 AND 670 MeV/c. Wong, Nai-Sitt. New Haven: Yale Univ. (1969). 114p.

Thesis.

There were 140,000 pictures of K^- with momentum settings 449, 472, 493, 533, 580, 612, 643 and 671 MeV/c taken in the 30" liquid hydrogen bubble chamber at Brookhaven National Laboratory. From the analysis of 43,000 events, partial cross sections and angular distributions for the two body channels $K^- + p \rightarrow K^- + p$, $\bar{K}^0 + n$, $\Sigma^+ + \pi^-$, $\Sigma^- + \pi^+$, $\Sigma^0 + \pi^0$, $\Lambda + \pi^0$ as well as the polarizations of the Λ and Σ^+ hyperons were measured. A method of analysis based on weighting each event with the resolution functions was employed to separate the $\Lambda\pi^0$ and the $\Sigma^0\pi^0$ final states. The experimental data have been partial wave analysed with the

scattering amplitudes parametrized in terms of a real and symmetric reaction matrix so as to satisfy the restrictions imposed by unitarity and time reversal invariance. Apart from the Λ(1520) whose quantum numbers are well-known, no other resonant states are required by the data in this energy region. Based on the partial cross section in the $\Lambda\pi^0$ channel, an upper limit of 0.050 was set for the elasticity of the recently proposed Σ(1616) resonance. (Diss. Abstr.)

32971 REACTIONS OF STOPPING K^- IN HELIUM. Katz, P. A. (Argonne National Lab., Ill. Univ. of Minnesota, Minneapolis); Bunnell, K.; Derrick, M.; Fields, T.; Hyman, L. G.; Keyes, G. Phys. Rev., D; 1: 1267-76(1 Mar 1970).

Branching ratios were measured for reactions initiated by negative kaons coming to rest in a helium bubble chamber. The data were obtained from an analysis of ~1000 events found in a careful scan using a very limited fiducial volume. Charged-Σ emission accounts for (30.8 ± 3.2)% of the absorptions and Λ/Σ^0 emission for (69.2 ± 6.6)%. Evidence for Σ-to-Λ conversion is clearly seen in the events with a visible Λ + π^-, and (66 ± 9)% of this final state results from such a process. Multinucleon (i.e., nonpionic) absorption is found to occur in (16.5 ± 2.6)% of the events, which is similar to the results reported from studies using heavy-liquid bubble chambers and nuclear emulsion. In general, the kinematic spectra for single-nucleon absorption events agree well with the predictions of a simple impulse approximation. The ratio of K^- capture on neutrons to that on protons is examined using the $\Lambda\pi^-He^3$ and the $\Lambda\pi^0H^3$ final states. The data for charged- and neutral-particle emission are consistent with the predictions of isospin invariance for kaon absorption in He^4. (auth)

32972 CHARGE RATIO OF 1- TO 10-TeV COSMIC-RAY MUONS. Parker, John Henry Jr. Salt Lake City; Univ. of Utah (1969). 93p.
Thesis.

The charge ratio of muons in the zenith range 40 to 90° with production energies greater than 1 TeV (a decade above previous experiments) was determined using the Park City kiloton neutrino detector. Approximately 90 days live time resulted in 7482 useable muons with a consolidated plus to minus ratio of 1.29 ± 0.03. The charge ratio as a function of energy and zenith angle is shown to be consistent with a simple model in which a process of direct muon production with unity charge ratio becomes dominant above a few TeV. The data are inconsistent with muon production from pionization or from isobar decay unless some process which decreases the charge ratio at higher energies is involved. The unique design of the detector permitted a measurement of the charge ratio (0.91 ± 0.14) of muons observed to be part of a multiple muon event and a direct measurement of the fraction (0.03 ± 0.02) of positive muons counted as negative and vice versa, which increases the charge ratio and its error flag by a negligible amount. (Diss. Abstr.)

32973 ISOSPIN CONSERVATION TEST FROM K^-p INTERACTIONS AT 400 MeV/c. Thompson, Julia Ann. New Haven; Yale Univ. (1969). 132p.
Thesis.

K^0n, $\Lambda\pi^0$, and $\Sigma^0\pi^0$ absolute and differential cross sections, and $\Lambda^0\pi$ and $\Sigma^0\pi^0$ differential polarizations are obtained from approximately one-third of a million picture exposure to the K^- separated beam in the thirty inch hydrogen bubble chamber at the Brookhaven Alternating Gradient Synchrocyclotron, with the K^- beam momentum in the middle of the chamber at two central values, 375 and 415 MeV/c. Partial wave solutions are found for the Legendre coefficients, and an upper limit is set on the Λ^0/Σ^0 isospin mixing parameter θ due to electromagnetic interactions: Λ(physical) = Λ(isospin zero) cos θ + Σ^0 (isospin one) sin θ. (Diss. Abstr.)

32974 CROSS SECTIONS FOR INCLUSIVE EXPERIMENTS. Piotrowska, H. (Warsaw Univ.). Phys. Lett.; 32B: 71-2(25 May 1970).

The cross sections for inclusive reactions: $\pi + p \rightarrow N$ (of given x,Q) + anything and $\pi + p \rightarrow \pi$ (of given x,Q) + anything are shown to remain approximately constant for 8, 11 and 16 GeV incident π energy. (auth)

Particle Interactions and Properties (Theoretical)

General

32975 (ITF-70-22) SOLUTION OF THREE-PARTICLE INTEGRAL EQUATIONS BY THE SEPARABLE EXPANSION METHOD. Kharchenko, V. F.; Petrov, N. M.; Kuz'michev, V. E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 15p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Use of a separable expansion for the two-particle t-matrix reduces the problem of three particles with pair interaction to a set of one-dimensional integral equations. By the subsequent separable representation of kernels of such integral equations (based on the Bateman method) the problem of three identical particles is reduced to the solution of a set of algebraic equations. (auth)

32976 SYMBOLIC ANALYSIS OF FEYNMAN DIAGRAMS BY COMPUTER. Campbell, J. A. (Univ. of Texas, Austin); Hearn, Anthony C. Contract F44620-68-C-0075. J. Comput. Phys.; 5: 280-327(Apr 1970).

A system of programs is described in the language LISP 1.5 which handles all stages of calculation from the specification of an elementary-particle process in terms of a Hamiltonian of interaction or Feynman diagrams to the derivation of an absolute square of the matrix element for the process. Examples of significant parts of the programs are presented, while a detailed listing of this material is contained. (auth)

32977 BOUND STATES OF A THREE-PARTICLE NONRELATIVISTIC SYSTEM. Atanasov, A. A. (Higher Pedagogical Inst., Plovdiv, Bulgaria). Acta Phys. Pol.; A37: 337-43(Mar 1970).

The problem of finding the energies of the bound states of a three-particle nonrelativistic system with two-body interactions is reduced to the determination of the eigenvalues of a Hermitian operator. An algorithm is proposed, under certain assumptions concerning the two-body interactions, for approximate determination of the energies of the bound states in case of degenerate and nondegenerate states. In principle the energies can be determined with approximate accuracy. (auth)

32978 HIGH ENERGY PHYSICS INDEX. VOLUME 8, NO. 10, 16 MAY 1970. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1970). 66p.

32979 ANALYTIC FORM FACTORS FOR ANY SPIN. Williams, D. N.; Yao, York-Peng (Univ. of Michigan, Ann Arbor). Phys. Rev., D; 1: 1380-8(1 Mar 1970).

Using the Fierz–Bargmann–Wigner basis, independent covariants, free of kinematic singularities and zeros, are constructed for vertices in which two external particles carry arbitrary spins, with one off-mass-shell leg corresponding to a totally symmetric Lorentz tensor. Results for (pseudo) scalars, (pseudo) vectors, and symmetric tensors of second rank are tabulated explicitly. (auth)

32980 TRANSVERSITY AMPLITUDES AND THEIR APPLICATION TO THE STUDY OF COLLISIONS OF PARTICLES WITH SPIN. Kotanski, A. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B1: 45-58(1970).

The principal properties of the transversity amplitudes (i.e., amplitudes with spins projected on the normal to the reaction plane) are presented. The properties which are important for applications, as the simplicity of crossing relations and the behavior under spatial reflections are discussed in detail. The applications to the study of behavior of scattering amplitudes at thresholds and pseudothresholds and to the description of spin correlations in decay distributions are also presented. Finally many other applications (including those proposed previously are briefly discussed. (auth)

Electromagnetic

Refer also to abstracts 32998, 33002, 33004, 33039, and 33047.

32981 (LA-4448) APPROXIMATION FOR THE INVERSE OF THE KLEIN–NISHINA PROBABILITY DISTRIBUTION. Everett, C. J.; Cashwell, E. D. (Los Alamos Scientific Lab., N. Mex.). May 1970. Contract W-7405-eng-36. 4p. Dep. CFSTI.

Approximate formulas, convenient for machine computation, and required in Monte Carlo practice, are given for the inverse of the Klein–Nishina probability distribution, permitting the direct determination of the energy E′ of a Compton-scattered photon, from a uniformly distributed random number. The relative error does not exceed 3.2% over the range $0.001 \leq E < 100$ MeV of incident photon energies, and is usually much less, being at most 1%, for example, when $E' \geq .3E$ and $E/mc^2 > 4$. (auth)

32982 ELECTRON–POSITRON ANNIHILATION AT HIGH ENERGY. Landshoff, P. V. (CERN, Geneva). Phys. Lett.; 32B: 57-60(25 May 1970).

The connection between the structure functions νW_2 and $\nu \overline{W}_2$ of deep inelastic electron scattering and electron–positron annihilation is discussed. A Veneziano-like model that gives a good fit with experiment for νW_2 suggests that it may be $\overline{W}_2$, rather than $\nu \overline{W}_2$, that obeys a scaling law. (auth)

32983 MAGNETIC MOMENT OF A PARTICLE WITH ARBITRARY SPIN. Hagen, C. R.; Hurley, W. J. (Univ. of Rochester, N. Y.). Phys. Rev. Lett.; 24: 1381-4(15 Jun 1970).

The magnetic moment of a particle of nonzero spin S is computed by the introduction of minimal coupling into the appropriate Galilean-invariant wave equation. It is shown that the requirement that the differential equations be of first order, together with a minimality assumption on the number of components, uniquely implies a g factor of 1/S. The role played by this minimality condition is made explicit by means of a counterexample. (auth)

32984 UNIVERSAL ISOVECTOR CURRENT WITH MANY 1^- POLES. Nussinov, S. (Brookhaven National Lab., Upton, N. Y. Tel-Aviv Univ., Israel); Rosner, J. Contract AT(11-1)-1764. Phys. Rev., D; 1: 656-9(15 Jan 1970).

A simple prescription is suggested for preserving universality of the isovector current in the presence of many 1^- poles ρ_i. By identifying $g_{\rho_i\gamma}$ as proportional to $g_{\rho_i\pi\pi}$, predictions are made regarding (a) the modification of the Kawarabayashi–Suzuki–Riazuddin–Fayyazuddin relation, (b) charge radii, (c) $\pi\pi$ resonance production in colliding beam experiments, (d) high-energy ρ meson photoproduction and photoabsorption, (e) photoproduction of ρ' and ρ'', and (f) asymptotic behavior of form factors. (auth)

32985 QUARK MODEL PREDICTIONS FOR PHOTOPRODUCTION OF RESONANCES. Kotanski, A. (Jagellonian Univ., Krakow); Zalewski, K. Acta Phys. Pol.; B1: 37-44(1970).

The quark model predictions for the decay distributions of resonances photoproduced in the reactions $\gamma B \to PB^*$, $\gamma B \to VB$ and $\gamma B \to VB^*$ are given. The numbers of relations predicted for the three reactions are: three, three and sixty respectively. (auth)

32986 FORWARD COMPTON SCATTERING. Damashek, Marc; Gilman, Frederick J. (Stanford Univ., Calif.). Phys. Rev., D; 1: 1319-32(1 Mar 1970).

An analysis of the recently measured photon–proton total cross sections is performed. Smooth fits to the cross sections are obtained and used to calculate, by means of the forward dispersion relation, the real part of the spin-averaged forward amplitude. The resulting predictions for the real part are given. At high energies, the fits to the present total cross-section data, together with the calculated real part, suggest the presence in the high-energy behavior of an extra real constant in addition to what one would have predicted from Regge theory and the high-energy behavior of the imaginary part. This extra real constant, which is consistent in sign and magnitude with the Thomson limit, $-\alpha/M_N$, could correspond to a fixed pole at J = 0 in Regge-pole language. Possible ways to test the forward dispersion relation are discussed. (auth)

32987 POLARIZATION CROSS SECTIONS IN PROTON COMPTON SCATTERING. Greenhut, Gary K. (Northwestern Univ., Boston). Phys. Rev., D; 1: 1341-9(1 Mar 1970).

A phenomenological amplitude for proton Compton scattering is obtained, and fits are made to the differential cross-section data. The amplitude is used to calculate the cross sections for the Compton scattering of polarized photons and the polarization of the recoil proton. It is found that the polarized-photon cross sections are sensitive to the amount of P_{11} resonance in the scattering amplitude. (auth)

32988 COMMENT ON HIGH-ENERGY WIDE-ANGLE PROTON COMPTON SCATTERING. Harte, John (Yale Univ., New Haven). Phys. Rev., D; 1: 1512(1 Mar 1970).

A bootstrap theory of the hadrons satisfying crossing symmetry and asymptotic unitarity which was recently proposed by the author is shown to lead to an interesting and testable prediction for high-energy wide-angle proton Compton scattering. (auth)

32989 STATISTICAL MODEL FOR ELECTRON–POSITRON ANNIHILATION INTO HADRONS. Bjorken, James D.; Brodsky, Stanley J. (Stanford Univ., Calif.). Phys. Rev., D; 1: 1416-20(1 Mar 1970).

A statistical model for the production of multibody hadronic states by e^+e^- annihilation is discussed. The secondary hadron momentum distributions for colliding beam processes is associated with the exponentially falling transverse–momentum distributions in hadron–hadron collisions. The consequence of this picture is that at high energies hadron multiplicity rises linearly with c.m. energy, unlike the lns behavior for the multiplicity of secondaries in hadron–hadron collisions. If the total annihilation cross section is assumed to have a power falloff $\sim s^{-m}$, the n-pion cross sections follow a Poisson distribution with the most probable multiplicity $n_\pi = s^{\frac{1}{4}}/\langle E_\pi \rangle + 3 - m$ and $\langle E_\pi \rangle \sim 375$ MeV. An alternative statistical model based on jets is also briefly discussed. The storage rings now being constructed or envisaged should easily distinguish between the various possibilities. (auth)

32990 ρ^0–ω INTERFERENCE. Horn, D. (California Inst. of Tech., Pasadena). Contract AT(11-1)-68. Phys. Rev., D; 1: 1421-6(1 Mar 1970).

The structure of $\rho^0 - \omega$ interference is discussed. Applications are made to photoproduction of 3π states, $\pi^+\pi^-$ production in electron–positron colliding beams, as well as in other processes, and lepton-pair photoproduction. The various parameters that appear in all these experiments are discussed, and the correlations of the various results are pointed out. (auth)

32991 ELECTROMAGNETIC MASON DECAYS FROM AN EFFECTIVE LAGRANGIAN WITH CHIRAL SYMMETRY. Gounaris, G. J. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., D; 1: 1426-31(1 Mar 1970).

A nonet-symmetrical and PCAC-violating term is introduced into a Lagrangian with $SU_3 \otimes SU_3$ chiral symmetry and PCAC (hypothesis of partially conserved axial-vector current). Breaking of the nonet symmetry of this term is achieved through the renormalization of the fields. This renormalization is necessary because of the requirement that the kinetic-energy terms of the Lagrangian be correctly normalized after the removal of the tadpole terms. Using as input the decay rate for $\pi^0 \to 2\gamma$, $\Gamma(\eta \to 2\gamma) = 0.41 \pm 0.08$ keV and $\Gamma(X^0 \to 2\gamma) = 6 \pm 1$ keV are predicted. The result for $\Gamma(\eta \to 2\gamma)$ agrees with experiment within 2 standard deviations. It is argued that errors of about 20% should be expected in the calculations, mainly because of the neglect of the effects due to the finite width of the various particles. (auth)

32992 COMPARISON OF THE SCATTERING OF ELECTRONS AND POSITRONS FROM PROTONS AT SMALL ANGLES. Brown, R. W. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., D; 1: 1432-4(1 Mar 1970).

The ratio of the cross section for elastic positron–proton scattering to that for elastic electron–proton scattering is studied. In first-order α, the leading terms of this ratio for small-angle scattering are given. As could be expected, the first term in this "expansion" is the same as that obtained in Dirac theory, and the first plus the second are unchanged from the structureless-proton result. Only in the third term is found proton structure, this in the form of a sum rule over photoproduction cross sections. Use is made of an off-mass-shell analog of the Compton low-energy theorem, and as a by-product it is shown that the two-photon contribution to our ratio is finite in the limit of zero electron mass. (auth)

32993 COMPTON TERMS IN INELASTIC PHOTOPRODUCTION OF MUON PAIRS. Bjorken, J. D.; Paschos, E. A. (Stanford Univ., Calif.). Phys. Rev., D; 1: 1450-1(1 Mar 1970).

Given the parton model of the nucleon, the cross section for photoproduction of high-energy muon pairs of small invariant mass and high transverse momentum is estimated. (auth)

32994 VECTOR-MESON AND DIPION PRODUCTION IN LEPTON–NUCLEON COLLISIONS. Pais, A. (Rockefeller Univ., New York). Phys. Rev., D; 1: 1349-56(1 Mar 1970).

The electroproduction of ρ, ω, and ϕ mesons is discussed. The spin-density matrix elements are shown to satisfy a number of conditions if and where the production is dominated by Pomeranchuk exchange. Constraints are also given for the case that a single spin-parity (of type $0^\pm$, $1^\pm$) dominates the t channel in some kinematic region. The extension to the production of a 2π continuum is straightforward. Vector-meson and 2π production by neutrinos is also treated. (auth)

32995 INELASTIC SCATTERING OF POLARIZED LEPTONS FROM POLARIZED NUCLEONS. Bjorken, J. D. (Stanford Univ., Calif.). Phys. Rev., D; 1: 1376-9(1 Mar 1970).

A previously derived sum rule, based on $U(6) \otimes U(6)$ equal-time commutation relations for the space components of the electromagnetic current, implies mean polarization asymmetries of greater than 20% througout most of the inelastic continuum. (auth)

32996 ASYMPTOTIC BOUNDS ON FORM FACTORS. Fuchs, Norman H.; Kuo, T. K. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-1428. Phys. Rev., D; 1: 1357-9(1 Mar 1970).

Starting from the equal-time commutator of the vector currents and the assumption that the contributions from "exotic channels" are small, bounds on the asymptotic behaviors of various form factors are found. For instance, the pion electromagnetic form factor and both of the K_{l3} form factors are found to be bounded by $1/\sqrt{|t|}$ as $|t| \to \infty$. Implications of this result for K_{l3} decay are analyzed. (auth)

32997 PHOTOPRODUCTION OF ELECTRON PAIRS AS A TEST OF QUANTUM ELECTRODYNAMICS. Biggs, P. J.; Braben, D. W.; Clifft, R. W.; Gabathuler, E.; Kitching, P.; Rand, R. E. (Science Research Council, Daresbury, Eng.). Phys. Rev., D; 1: 1252-66(1 Mar 1970).

As a test of the validity of quantum electrodynamics (QED) for heavy virtual leptons, cross sections for wide-angle electron-pair photoproduction were measured using hydrogen and carbon targets. Electron pairs were detected in two independent mirror-image spectrometers which identified production angles and momenta. A symmetrical arrangement was used in which interference between Bethe–Heitler and virtual Compton graphs is identically zero. Data were obtained at electron production angles from 5° to 7° and momenta from 1 to 2 GeV/c, and were compared with theory by means of a Monte Carlo calculation. Up to the maximum invariant mass of the electron pair 489 MeV/c^2, the data are consistent with the predictions of QED for both targets, confirming the results of other recent wide-angle pair-production and bremsstrahlung experiments in this energy range. Expressing the results in terms of a cutoff parameter Λ, where any positive deviation from QED is proportional to $\Lambda^{-4}Q_l^4$ (where Q_l is the mass of the virtual lepton), $\Lambda > 0.76$ GeV/c^2 is obtained with 95% confidence. For a similar negative deviation, $\Lambda > 0.55$ GeV/c^2. (auth)

Weak

Refer also to abstracts 32994 and 32996.

32998 $\bar{\nu}_e + e \to \bar{\nu}_e + e$ PROCESS. Bardin, D. Yu; Bilenkii, S. M.; Pontecorvo, B. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett.; 32B: 68-70(25 May 1970).

The scattering of antineutrinos by electrons is considered under different assumptions about the ν_e-e-interaction. The recoil electron spectra are calculated for the practical case where the antineutrino source is a uranium reactor. It is shown that even rough measurements of the electron spectrum would allow the drawing of important conclusions about the nature of the interaction. (auth)

32999 CURRENTS, SPECTRAL FUNCTIONS, AND THEIR APPLICATIONS AND A DISPERSION APPROACH TO INTERFERENCE MODEL, LOCAL DUALITY PRINCIPLE AND PHOTON–NEUTRON MASS DIFFERENCE. Hsu, Jong-ping. New York; Univ. of Rochester (1969). 156p.

Thesis.

The results of spectral function sum rules, current algebra, SU(3) and superconvergence are examined. The corrections to the Weinberg sum rules due to nonvanishing pion and kaon masses are discussed. The new sum rules for the spectral functions are then obtained. These new sum rules, the SU(3), and the superconvergence are applied to calculate the K_{l3} form factors. Two different methods are used to calculate the K_{l3} form factors, the results are consistent and in good agreement with the polarization experiment. The decay widths of some vector mesons are also calculated by using the similar technique. The results are again in agreement with the experiment. The nonleptonic decays of hyperons are discussed by using the currents of SU(3) and the concept of intermediate vector boson for the weak interactions. The intermediate vector boson is assumed to be weakly coupled with both the baryon current and the pion. The $\Delta I = \frac{1}{2}$ rule is built in the Lagrangian, and both the S-wave and the P-wave amplitudes can be fitted by the theory. Further, a new sum rule for the P-wave amplitude is obtained, which is in excellent agreement with experiments. It is shown based on the new spectral function sum rules, that the electromagnetic mass difference of pions is $m(\pi^+)-m(\pi^0) = 4.7$ MeV, which is in excellent agreement with the experimental value 4.6 MeV. Here it is not assumed that the axial-vector currents are divergenceless or $m(\pi) = 0$. The dispersion relations are used to obtain an interpolation formula for the amplitude which would have low-energy resonant behavior and high-energy Regge behavior. The method may be applied to both single- and multi-Regge exchange cases. A sum rule relating the Regge terms and the resonant terms is obtained, and it holds well throughout the low energy and the intermediate energy regions. The same technique is also applied to calculate the proton–neutron mass difference. The result shows much improvement in comparison with the old calculations. (Diss. Abstr.)

33000 UNIVERSALITY OF THE WEAK VECTOR COUPLING CONSTANT. Dicus, Duane A.; Norton, Richard E. (Univ. of California, Los Angeles). Phys. Rev., D; 1: 1360-73(1 Mar 1970).

A previous calculation of the radiative corrections to the rate for pure Fermi β decay in the V–A theory, computed to first order in α and to zero order in the lepton momenta, is extended here to include, in addition, the corrections linear in the product of a lepton momentum and a nuclear charge radius. These additional contributions are shown to modify the Coulomb correction to the positron wave function to account for the finite distribution of electric and isotopic charge within the nucleus. They are evaluated and taken together with the other electromagnetic corrections, the origin of which are reviewed in the text, to reassess the question of the universality of the weak vector coupling constant. The conclusions obtained, although basically in agreement with the results of others, differ in detail from previous surveys of universality, generally in a direction to strengthen the concept of universality in the sense of Cabibbo. (auth)

33001 THREE-POINT FUNCTIONS AND A SUM RULE FROM RADIATIVE CORRECTIONS TO PION β DECAY: A UNIFIED DESCRIPTION OF LOW-ENERGY MESON PHENOMENA. Namaizawa, Hiroshi (Univ., Kyoto. Seikei Univ., Tokyo). Phys. Rev., D; 1: 1388-1404(1 Mar 1970).

Combining conserved vector current, partially conserved axial-vector current, and the meson-dominance approximation, a theory of current algebra ($SU_3 \otimes SU_3$) "on the mass shell" is derived by means of Ward-Takahashi-type identities for three-point functions. Models of mixing are presented which are compatible with the spectral-function sum rules derived from broken chiral $SU_3 \otimes SU_3$ symmetry and with CVC to the first order of symmetry breaking. Further, requiring absence of divergences from radiative corrections to pion β decays an asymptotic sum rule is deduced which relates two different types of three-point functions and thus allows a correlation between two different meson processes: radiative and strong decays. In addition to these decay processes, applications are made to electromagnetic form factors of mesons, K_{l3} form factors, and $\pi(K) \to l\nu\gamma$ decays. Agreement with experiments is very reasonable. (auth)

33002 MAGNETIC RADIATION IN $K^\pm \to \pi^\pm\pi^0\gamma$ DECAYS. Dass, G. V. (Rutherford Lab., Chilton, Eng.); Kamal, A. N. Phys. Rev., D; 1: 1373-5(1 Mar 1970).

An estimate of the strength of the magnetic radiation term in $K^\pm \to \pi^\pm\pi^0\gamma$ decays is made by relating it to the τ^+ decay rate and using the Veneziano model to give the off-mass-shell dependence of the amplitudes. This strength to be small ($|x_m| \leq 0.14$) and practically constant in the kinetic-energy range 55 MeV $\leq T_{\pi^+} \leq$ 80 MeV. The results are discussed in the light of $K^\pm \to \pi^\pm\pi^0\gamma$ data, particularly for possible CP-violating effects. (auth)

33003 ASYMPTOTIC WEAK INELASTIC PRODUCTION IN A DIFFRACTION MODEL. Griffith, Richard W. (Argonne National Lab., Ill.). Phys. Rev., D; 1: 1494-8(1 Mar 1970).

A high-energy small-angle eikonal model suggested previously for a diffraction regime in inelastic ep scattering is reviewed and applied to weak (neutrino-induced) inelastic production. In neutrino production channels, the observed trend for dominance of N* (plus associated mesons) over ρ-type events is qualitatively contained in the model. A reasonable estimate of the linear rise with neutrino energy of $\sigma(\nu p \to \mu^- + \text{hadrons})$ is discussed, especially from general considerations. (auth)

33004 RADIATIVE CORRECTION TO K_{l3} DECAY. Becherrawy, T. (Univ. of Rochester, N. Y.). Phys. Rev., D; 1: 1452-68 (1 Mar 1970).

The radiative corrections to K_{l3} decay are studied, assuming that the strong interactions introduce a natural cutoff for the electromagnetic interactions of the hadrons. The strong interactions are taken into account by the electromagnetic form factors of the hadrons, for which the vector-meson-dominance model is assumed. The radiative corrections are found to be large for some energy configurations, but the correction to the K_{e3} decay rate is about −2%. This is larger than the −0.45% value previously estimated by Ginsberg. The correction to the $K_{\mu3}$ decay rate is about −0.4%, and the correction to the polarization of the muon is about −1%. (auth)

33005 RELATIVE PHASE ANGLES IN LEPTONIC DECAY OF PHOTOPRODUCED VECTOR MESONS. Greenhut, Gary K. (Northwestern Univ., Boston); Weinstein, Roy; Parsons, Ronald G. Phys. Rev., D; 1: 1308-11(1 Mar 1970).

Interference effects in the leptonic decay modes of photoproduced ρ, ω, and φ mesons are considered. Two experimental methods for determining the relative phase angles of the final-state muons are discussed. The phase-angle difference between the ρ and ω is estimated from existing data and appears to be in disagreement with the value of 0°. (auth)

33006 UPPER LIMIT ON THE STRUCTURE-DEPENDENT RADIATION IN $K^+ \rightarrow e^+ + \nu_e + \gamma$. Macek, R. J.; Mann, A. K.; McFarlane, W. K; Roberts, J. B. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., D; 1: 1249-52(1 Mar 1970).

An upper limit to the branching ratio for the so-called structure-dependent radiation in the radiative decay mode $K^+ \rightarrow e^+ + \nu^e + \gamma$ was determined. The measurement was made by searching for moderate-energy photons in large-angle coincidence with positrons in the momentum region above the maximum allowed in K^+_{e3} decay and below the momentum of K^+_{e2}. The result yielded with 90% confidence $\Gamma^{SD}_{e\nu\gamma}/\Gamma$ (all) $< 7.1 \times 10^{-5}$ assuming $\gamma_K \equiv A_K(0)/V_K(0) \geq 0$. This in turn yields $|V_K(0)| < 0.24\ M_K^{-1}$, which is consistent with K* dominance. (auth)

Strong (General)

33007 HADRON DYNAMICS. Kuti, Gyula (Lorant Eoetvoes Univ., Budapest). Magy. Fiz. Foly.; 17: 381-422(1969). (In Hungarian).

The strong and weak interactions of hadrons are analyzed in collision phenomena. Because of the ever-present electromagnetism and weak coupling, only very few truly stable particles are encountered; most collisions generate a resonant state with a finite life. The strong hadron interactions present the most important problem. Potential scattering, dynamics of resonance states, and the relativistic S-matrix theory are examined, on the basis of the function of the energy-pulse variable of the particles, assuming that the energy-momentum representation of the S-matrix is a reliable reflection of the observations. It is pointed out that the S-matrix theory does not have as strict a mathematical basis as the axiomatic field theory. The boot strap dynamics is also taken into account. (Review article). (TTT)

33008 UPPER BOUNDS ON THE ELASTIC DIFFERENTIAL CROSS SECTION. Singh, Virendra; Roy, S. M. (Tata Inst. of Fundamental Research, Bombay). Ann. Phys. (N. Y.); 57: 461-80(Apr 1970).

Improved axiomatic upper bounds on the elastic unpolarized differential cross section, $d\sigma/d\Omega$, at high energies are derived, for the scattering of particles with arbitrary spin. An upper bound is also given on differential cross section involving the diffraction peak width but not having an explicit ln s dependence. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 33005, 33018, and 33038.

33009 (ITEF-749) NONRELATIVISTIC CONNECTED STATES IN THE NUCLEON-ANTINUCLEON SYSTEM. Dal'karov, O. D.; Mandel'tsveig, V. B.; Shapiro, I. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1969. 20p. (In Russian). Dep. CFSTI (U. S. Sales Only).

It is shown, that in the mass region 1580 to 1880 MeV there are many meson resonances with widths about 20 to 100 MeV. These resonances are quasinuclear bound states of a nucleon-antinucleon system with quantum numbers: $J^{PC} = 0^-, 0^+, 1^-, 1^+$. (auth)

33010 (SU-1206-223) INTEGRAL INEQUALITIES FOR THE s- AND p-WAVE $\pi\pi$ PARTIAL-WAVE AMPLITUDES DUE TO CROSSING SYMMETRY AND POSITIVITY. Balachandran, A. P.; Blackmon, Maurice L. (Syracuse Univ., N. Y. Dept. of Physics). Mar 1970. 7p. (NYO-3399-223). Dep. CFSTI.

An infinite number of inequalities for the s- and p-wave $\pi\pi$ scattering amplitudes are derived. They follow from crossing symmetry and from the positivity of the even $l \geq 2$ partial waves of the reactions $\pi^0\pi^0 \rightarrow \pi^0$ and $\pi^0\pi^0 \rightarrow \pi^+\pi^-$ in the region $0 \leq s \leq 4m_\pi^2$. (auth)

33011 DEPENDENCE OF MESON MASSES ON SPIN ACCORDING TO SIMPLE MODELS. Tassie, L. J. (Australian National Univ., Canberra). Aust. J. Phys.; 23: 129-32(Apr 1970).

A simple quark-antiquark model yields mesons such that the square of the mass is proportional to the spin, when the interaction between quark and antiquark is taken to be a harmonic oscillator potential. Two other forms of the interaction between quark and antiquark are also considered, but yield results in disagreement with experiment. (Australia)

33012 SPIN-PARITY OF THE X^0 (960) MESON. Giler, S.; Klosinski, J.; Lefik, W.; Tybor, W. (Univ. of Lodz, Poland). Acta Phys. Pol.; A37: 475-6(Mar 1970).

The decay $X^0(960) \rightarrow \eta\pi^+\pi^-$ is analyzed in the current algebra approach. The argument in favor of $J^P = 2^-$ assignment for the $X^0(960)$ meson is given. (auth)

33013 CURRENT ALGEBRA AND UNITARITY. Schnitzer, Howard J. (Rockefeller Univ., New York). Phys. Rev. Lett.; 24: 1384-8(15 Jun 1970).

A method is presented for constructing current-algebra amplitudes which satisfy (1) threshold theorems, (2) crossing symmetry, (3) approximate unitarity, and (4) cutplane analyticity, and which reduce to the usual tree approximation in the narrow-resonance limit. Pion-pion scattering is considered in detail to illustrate the method. A derivation of the Kawarabyashi-Suzuki-Riazuddin-Fayyazuddin relation is provided which makes no reference to vector-meson dominance. (auth)

33014 MODEL OF SPONTANEOUS BREAKDOWN OF SU(3) ⊗ SU(3) SYMMETRY. I. Bhargava, Ashok Kumar; Dass, Tulsi (Indian Inst. of Tech., Kanpur). Phys. Rev., D; 1: 649-56(15 Jan 1970).

Strong interactions of spin-zero and spin-one mesons are studied in a model in which the Lagrangian is approximately invariant under coordinate-dependent SU(3) ⊗ SU(3) gauge transformations. The scalar and pseudoscalar nonets are assigned to the $(3,3^*) \oplus (3^*,3)$ representation, whereas the vector and axialvector octets are introduced as gauge fields belonging to the $(1,8) \oplus (8,1)$ representation. Spontaneous symmetry breaking to the isospin-hypercharge level is introduced by giving nonzero vacuum expectation values to some scalar fields. The effective Lagrangian obtained after considering field mixings and renormalizations is used in a phenomenological manner to study the masses and couplings of various particles. With some of the experimental meson masses as input, the predicted masses of remaining observed mesons are in reasonable agreement with experiment. Some scalar-meson masses are also predicted ($\mu_{S_K} = 527$ MeV and $\mu_{S_\pi} = 771$ MeV). The widths for $V \rightarrow PP$ and $A \rightarrow VP$ decays are calculated and compare well with experiment. The axial-vector currents and the strangeness-changing vector currents satisfy partial conservation equations. Decay constants for spin-zero mesons are calculated. $F_K/F_\pi = 1.17$ and $F_{S_K}/F_{S_\pi} = -0.59$ are obtained. The K_{l3} form factors are calculated, the effect of the scalar kaon being included; we get $f_+(0) = 0.86$, $\xi = -0.197$, $\lambda_+ = 0.023$, and $\lambda_- = 0.013$. (auth)

33015 K_L AND K_S AS SHELL-MODEL EIGENSTATES. McVoy, K. W.; Romo, W. J. (Argonne National Lab., Ill.). Ann. Phys. (N. Y.); 57: 496-9(Apr 1970).

The reaction formalism of Feshbach and MacDonald is used to rederive the results of the Wigner-Weisskopf treatment for the neutral K-meson system. The derivation of the Bell-Steinberger sum rule is particularly transparent in this approach. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 32969 and 32974.

33016 (DESY-70/18) UNIVERSALITY OF THE TWO-PION ISOVECTOR COUPLING. Fabricius, K.; Kramer, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Apr 1970. 25p. Dep. CFSTI (U. S. Sales Only).

The Adler-Weisberger universality is derived from a new gauge invariance of the S-matrix. Then former attempts to prove the universality of pion-baryon scattering from the Adler self-consistency condition are discussed and a counter example is given. The result is compared with the experimental data. (auth)

33017 (IFVE-STF-69-43) ESTIMATE OF THE REGION OF INTERMEDIATE ENERGIES IN DISPERSION RULES FOR SUMS. Aznauryan, I. G.; Solov'ev, L. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1969. 24p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The method for the estimation of the contribution of the intermediate energy region into dispersion sum rules is considered. This method permits one to obtain parameters, describing processes at high energies from the low energy phase-analysis. The

method is used to obtain the Regge residue functions of pion–nucleon scattering amplitudes $B^{(+)}(\nu,t)$ and $B^{(-)}(\nu,t)$. The rotation of polarization in $\pi^{\pm}p$-high-energy scattering in the framework of the Regge pole model is predicted. (auth)

33018 UPPER BOUNDS ON PARTICLE–ANTIPARTICLE TOTAL CROSS SECTION DIFFERENCES AT HIGH ENERGIES. Roy, S. M.; Singh, V. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett.; 32B: 50-4(25 May 1970).

Axiomatic asymptotic upper bounds on particle-antiparticle total cross section differences are derived for pion-nucleon, kaon-nucleon and nucleon-nucleon scattering. Comparison with Serpukhov data is also given. (auth)

33019 SOME CONSEQUENCES OF A POSSIBLE VIOLATION OF THE POMERANCHUK THEOREM FOR KN SCATTERING. Dumbrais, O. V.; Queen, N. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett.; 32B: 65-7(25 May 1970).

It is shown from a dispersion relation that, at energies accessible to existing of proposed accelerators, the phases of the $K^{\pm}N$ forward scattering amplitudes and the K^0 regeneration amplitudes on protons and on nuclei are sensitive to the asymptotic behavior of the total cross sections. (auth)

33020 FIXED u CONTINUOUS MOMENT SUM RULES FOR Kp SCATTERING AND $\Lambda_\alpha - \Lambda_\gamma$ EXCHANGE-DEGENERACY. Golab-Meyer, Z. (Jagellonian Univ., Krakow); Kwiecinski, J. Acta. Phys. Pol.; B1: 17-29(1970).

The fixed u continuous moment sum rules for meson-nucleon scattering were derived and applied to the analysis of the Kp scattering amplitude. It was found that sum rules are compatible with the hypothesis of $\Lambda_\alpha - \Lambda_\gamma$ exchange-degenerate trajectory dominance. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 33018.

33021 INELASTIC SCREENING IN HIGH-ENERGY PION–DEUTERON SCATTERING. Gurvits, S. A.; Marinov, M. S. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett.; 32B: 55-6(25 May 1970).

By means of the Gribov theory and with experimental data on inelastic π^-p interactions it is shown that the nuclear screening in π^-d scattering at 16 GeV/c with account of the inelastic channels is about 50% higher than the elastic shadow effect. With the energy rise to 65 GeV (the Serpukhov limit) the inelastic screening may be expected to decrease. (auth)

33022 LOW-ENERGY NEUTRON–NEUTRON SCATTERING. Szego, Karoly; Toth, Kalman (Central Research Inst. for Physics, Budapest). Magy. Fiz. Foly.; 17: 423-44(1969). (In Hungarian).

Study of the low-energy nucleon-nucleon scattering yields valuable information on nuclear forces. The partial wave analysis for checking the results of dispersion theory is an important method for checking the theoretical results of dispersion. The steps involved in the obtaining of numerical values of phase shifts are outlined, defining the concept of phases and giving the latest experimental data involved in their measurements. Recent phase shift calculations indicate important new theoretical concepts of the N-N scattering. As the available data are not sufficiently accurate, the importance of such basic properties as the threshold behavior and certain analytical properties could not be examined. The recently introduced concept of "proper" and "improper" functions to account for the threshold and singularities derived from the S-matrix theory are also pointed out. (Review article, 22 references) (TTT)

33023 INTRANUCLEAR CASCADES TAKING INTO CONSIDERATION α-CLUSTERS. Barashenkov, V. S.; Abdinov, O. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B1: 65-70(1970). (In Russian).

Inelastic interactions of 660 MeV protons with carbon nuclei were used as an example in studies of intranuclear cascades in light nuclei considering direct interactions of cascade protons with α-clusters. The studies were limited to the model with a sharply outlined nucleus and uniform distribution of α clusters. The results of calculation of angular and energy distribution of secondary protons, distribution of excitation energies and the yield of the residual nucleus do not depend much on the cluster model parameters. Experiments and calculations for generated α-particles are in agreement only in the case in which α-clusters are taken into account. The best results were obtained in the case in which the probability of nucleon coagulation in α clusters was about 20%. (tr-auth)

33024 USE OF NEW DISPERSION RELATIONS IN THE GLAUBER FORMALISM WITH APPLICATION TO πd SCATTERING. McClure, J. A.; Jorna, S. (Georgetown Univ., Washington, D. C.). Nuovo Cim.; 67A: 667-77(21 Jun 1970).

The recently introduced dispersion relations for the logarithm of the scattering amplitude are combined with the Glauber formalism for scattering by composite systems. The dispersion relations yield the angular dependence of the phase of the single-particle amplitudes which can be substituted directly into the Glauber expressions. The total and differential cross-sections are then immediately calculable. The method is illustrated by a detailed treatment of πd elastic scattering, but is readily extended to other beam particles and targets. (auth)

33025 BINDING ENERGY OF A Λ PARTICLE IN NUCLEAR MATTER. Dabrowski, Janusz (International Centre for Theoretical Physics, Trieste, Italy. Warsaw Univ. Inst. for Nuclear Research, Warsaw).; Hassan, M. Y. M. Phys. Rev., C; 1: 1883-95(Jun 1970).

The binding energy of a Λ particle in nuclear matter, $B_\Lambda(\infty)$, is calculated self-consistently with the help of the Brueckner theory. In the K-matrix equations for the Λ-N interaction, pure kinetic energies in the intermediate states are used. The K-matrix equations are solved numerically. The rearrangement energy is taken into account. The values of $B_\Lambda(\infty)$ calculated with several central Λ-N potentials $v_{\Lambda N}$ — though smaller than the values obtained by other authors — are, in general, larger than the empirical value of $B_\Lambda(\infty)$. An agreement with this value is obtained only if $v_{\Lambda N}$, adjusted to the binding energy of $^5_\Lambda$He, has a sufficiently large hard core and is sufficiently suppressed in odd states. Possible ways of reducing the calculated value of $B_\Lambda(\infty)$ are discussed. A critical discussion of the independent-pair approximation applied by other authors in calculating $B_\Lambda(\infty)$ is presented. (auth)

Particle Invariance Principles and Symmetries

General

33026 GROUP-THEORY DYNAMICS. PART II. Gyoergyi, Geza (Central Research Inst. for Physics, Budapest. Inst. of Nuclear Physics, Orsay, France). Magy. Fiz. Foly.; 17: 459-67(1969). (In Hungarian).

J. Schwinger has shown that the quantum theory of the impulse momentum may be derived from a boson set by a second quantization. Making use of Dirac's quantization method in the study of dynamic systems and starting from a spatial fixed rotator, it was found possible to reach Schwinger's formalism. From the SO(3,2) generators, the solutions of the commutator relations defined by the operators of the rotator variables were derived; the SO(3,2) generators were obtained from oscillator (boson) operators. This leads directly to the Schwinger's derivation of the impulse-moment operator. (TTT)

33027 LIE ALGEBRA REPRESENTATIONS OF THE POINCARE GROUP. Flato, Moshe; Guillot, Jean-Claude; Sternheimer, Daniel (Univ., Paris). Compt. Rend., Ser. A; 270: 914-17(6 Apr 1970). (In French).

Classes of local representations of the Poincare group are built, using algebraically irreducible representations of the SL(2) Lie algebra. Possible applications to elementary particle physics are mentioned. (France)

33028 REPRESENTATIONS OF $U(4) \supset U(2) \otimes U(2)$. Brunet, M.; Resnikoff, M. (State Univ. of New York, Buffalo). J. Math. Phys. (N. Y.); 11: 1474-81(Apr 1970).

The state vectors associated with an irreducible representation of U(4) restricted to the subgroup $U(2) \otimes U(2)$ are explicitly constructed for the general 4-rowed Young diagram, employing Littlewood's rules and a theorem of Cartan. Expressions are given for the degeneracy of a $U(2) \otimes U(2)$ state in U(4), and the set of $U(2) \otimes U(2)$ states obtained are shown to be independent and complete. Operators which break this degeneracy are constructed, and the behavior of the state vector under the conjugation operations is also discussed. The results are useful for the nuclear quasispin and Wigner supermultiplet models. (auth)

33029 EXPLICIT REALIZATION OF E(2) SYMMETRY COMPATIBLE WITH THE ANALYTIC S MATRIX. Anderson, R. L.; Grynberg, M. (Inst. for Nuclear Research, Warsaw). Acta Phys. Pol.; B1: 71-6(1970).

An explicit mapping procedure is used to determine an approximate off zero-momentum transfer-squared symmetry group for the inelastic binary connected part. (auth)

33030 LIE GROUPS AND SYMMETRIC SPACES. Helgason, Sigurdur (Massachusetts Inst. of Tech., Cambridge). pp 1-71 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

The semisimple Lie groups are studied with emphasis on noncompact groups and the associated noncompact symmetric spaces. The function theory on these spaces is treated in detail, but holomorphic function theory is omitted. (J.F.P.)

33031 ONE-PARAMETER SUBGROUPS DO NOT FILL A NEIGHBORHOOD OF THE IDENTITY IN AN INFINITE-DIMENSIONAL LIE (PSEUDO-) GROUP. Freifeld, Charles (Harvard Univ., Cambridge, Mass.). pp 538-43 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

It is shown that a transformation close to the identity in a Lie (pseudo-) group cannot be joined to the identity transformation by a one-parameter family of transformations in the infinite case. A Lie (pseudo-) group means a set of local invertible analytic transformations on some manifold which are the solutions of a set of partial differential equations. The transformations C^∞ and analytic cases are considered. (J.F.P.)

Applications (Electromagnetic and Weak)

Refer also to abstracts 32957 and 33014.

33032 (LNF-70/11) POSSIBLE TEST OF C CONSERVATION IN THE DECAY OF POSITRONIUM. Note No. 469. Del Fabbro, R.; Matone, G.; Satta, L. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 23 Mar 1970. 7p. Dep. CFSTI (U. S. Sales Only).

The three-photon decay of positronium is studied by observing the interference term between ortho- and parapositronium. The analogy of the (e^+e^-) bound state with the $|K^0\rangle$, $|\overline{K}^0\rangle$ system, the quantum mixture in a microwave magnetic field, and interference effects due to C nonconservation are considered. (J.F.P.)

33033 MINIMAL ELECTROMAGNETIC COUPLING AS A CONSEQUENCE OF LORENTZ INVARIANCE. Levy-Leblond, Jean-Marc (Laboratoire de Physique Theorique, Paris). Ann. Phys. (N. Y.); 57: 481-95(Apr 1970).

Generalizing a result obtained by Jauch in the nonrelativistic case, it is shown how a suitably formulated principle of Lorentz invariance for a not necessarily free particle, restricts the possible form of its interaction with external fields to that deduced from the principle of minimal coupling ordinarily used for electromagnetic interactions. (auth)

Applications (Strong)

Refer also to abstract 33014.

33034 AN SU_4 MODEL FOR STRONG INTERACTIONS. Cohen, H. (California State Coll., Los Angeles). Nuovo Cim.; 67A: 577-83(21 Jun 1970).

A model of an approximate SU_4 symmetry for strong interactions is discussed. Unlike other investigators of SU_4 models, SU_4 is considered under the reduction $SU_2 \times SU_2 \times U_1$. Although several predictions are found which are not valid, two rather interesting results are obtained. (auth)

33035 DECAYS OF 2^+ MESONS, AND SU(6)-SYMMETRY. Kukhtin, V. V. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh., 14: 873-5(May 1969). (In Russian).

The possibility of classifying 2^+ mesons according to representations of the 189- and 405-intersections of the SU(6) group has been indicated recently. On the basis of SU(3)-symmetry with the taking into account of displacement 1-8 (in the 189-intersection) and of displacement 1-8-27 (in the 405-intersection) it is shown that inclusion of the 2^+ mesons in the 189-intersection contradicts the experimental data on the decays. It is assumed that the physical particles represent linear superpositions of states of unitary multiplets, and it is proposed that the matrix elements of the decays of SU(3) multiplets into two pseudoscalar mesons has a unitary structure. A comparison of the calculated values of the constants with experimental values is given in tabular form. (TTT)

Field Theories

Quantum Field Theory

Refer also to abstracts 32997 and 33026.

33036 (AD-702080) A SPACE-PROPER TIME FORMULATION OF RELATIVISTIC GEOMETRY. Physical Sciences Research Papers. Newburgh, R. G.; Phipps, T. E. Jr. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Nov 1969. 29p. (AFCRL-PSRP-401; AFCRL-69-518). CFSTI.

Any formulation of the theory of relativity specifies implicitly or explicitly the exactness or inexactness of the temporal and spatial differentials that occur. The Minkowski formulation implicitly assumes the exactness of coordinate (common) time and the inexactness of proper time. Several other possibilities are examined. The assumption of the exactness of proper time and inexactness of common time leads to a space-proper time (SPT) representation of events that yields the customary formal results of the theory including the differential aging prediction of the "twin paradox," allows an analog of Fermat's principle to describe both particles and light, and leads to a many-proper time formulation of the relativistic many-body problem essentially equivalent to the Minkowski space formualtion. Analogies between the SPT geometry and the geometric approach to thermodynamics, especially as formulated by Caratheodory, suggest the gamma function of relativity is an integrating factor with physical meaning for the many-body problem and also provides insight into the concept of virtual photons. (auth)

33037 (DESY-70/20) SMALL DISTANCE BEHAVIOUR IN FIELD THEORY AND POWER COUNTING. Symanzik, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1970. 34p. Dep. CFSTI (U. S. Sales Only).

For infinitesimal changes of vertex functions under infinitesimal variation of all renormalized parameters, linear combinations are found such that the net infinitesimal changes of all vertex functions are negligible relative to those functions themselves at large momenta in all orders of renormalized perturbation theory. The resulting linear first-order partial differential equations for the asymptotic forms of the vertex functions are, in quantum electrodynamics, solved in terms of one universal function of one variable and one function of one variable for each vertex function whereby, in contrast to the renormalization group treatment of this problem, the universal function is obtained from nonasymptotic considerations. A relation to the breaking of scale invariance in renormalizable theories is described. (auth)

33038 RIGOROUS QUANTUM FIELD THEORY MODELS. Glimm, J.; Jaffe, A. (Courant Inst. of Mathematical Sciences, New York. Harvard Univ., Cambridge, Mass.). Bull. Amer. Math. Soc.; 76: 407-10(Mar 1970).

Two standard nonlinear interactions in two space-time dimensions are studied. The main results include the mathematically rigorous construction of quantum field theory models for the interactions studied. The interactions for a nonlinear coupling of mesons and for the coupling between mesons and neutrons or protons are considered. (J.F.P.)

33039 CLASSICAL MOTION OF FASTER-THAN-LIGHT PARTICLES IN AN EXTERNAL FIELD. Glueck, M. (Univ., Hamburg). Nuovo Cim.; 67A: 659-66(21 Jun 1970).

The classical motion of tachyons in a Coulomb field is discussed. Bound-state energies and trajectories are found by utilizing the Bohr-Sommerfeld quantization rule. Cross sections are computed and compared with those of normal particles. (auth)

33040 RENORMALIZABLE APPROXIMATIONS IN FIELD THEORY. Marinaro, M.; Scarpetta, G. (Univ., Naples). Nuovo Cim.; 67B: 204-21(11 Jun 1970).

A method to construct approximations to a renormalizable field theory is presented. The obtained approximations preserve the renormalizability character of the complete theory and therefore can be advantageously used to study the properties of the renormalization group. For the sake of simplicity, we refer to the self-coupled neutral-boson-field theory with the interaction Lagrangian $L_I = g\varphi^4$. (auth)

33041 PROGRESS AND GOALS IN RENORMALIZATION THEORY. Hepp, Klaus (Eidgenoessische Technische Hochschule, Zurich). pp 333-53 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

The discussion of renormalization theory in relativistic quantum mechanics covers Fock space and renormalization of the Gali-Lee model, relativistic Hamiltonians, and the consistency of renormalized perturbation theory. (J.F.P.)

33042 PERTURBATION THEORY IN QUANTUM FIELD THEORY AND HOMOLOGY. Lascoux, Jean (Ecole Polytechnique, Paris). pp 354-419 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

The topics covered include the normal form of an integral from perturbation theory, analytical continuation by isotopy, applications in the Picard–Lefscheta formula, the Leray theory of residues, and the α representation for Feynman integrals. (J.F.P.)

33043 QUANTUM MECHANICS OF IDENTICAL PARTICLES. Ohnuki, Y. (Nagoya Univ., Japan); Kamefuchi, S. Ann. Phys. (N. Y.); 57: 543-78(Apr 1970).

The statement commonly made in the quantum mechanical theory of identical particles, that the characters of the symmetric group of particle permutations are constants of motion, is shown not to be always correct when paraparticles come into play. A general quantum mechanical theory, which can, as well, deal with paraparticles, is formulated on the basis of the corresponding parafield theory. It is shown that to describe such a general system, a multicomponent wavefunction is needed, with each component referring to each inequivalent irreducible subspace under particle permutations, and consequently that physical observables have the corresponding matrix-like structure. General properties of our formalism are studied in detail, and its connection with the usual formalism clarified. A further generalization of our formalism to include particles that do not obey parastatistics is also discussed. (auth)

33044 STRICTLY LOCALIZABLE FIELD THEORY AND THE CONSTRUCTION OF RESONANT-SYMMETRIC SCATTERING AMPLITUDES. Abarbanel, Henry D. I. (Princeton Univ., N. J.). Ann. Phys. (N. Y.); 57: 525-42(Apr 1970).

A straightforward realization of a strictly localizable quantum field theory is considered. Some properties of the fields are established. An explicit example of the ability of the "Born approximation" in this theory to yield crossing symmetric resonance amplitudes is discussed. (auth)

Gravitation and General Relativity

Refer also to abstract 32546.

33045 NONLINEAR RADIATIVE INTERACTIONS IN GENERAL RELATIVITY. Couch, W. E. (Univ. of Texas, Austin); Kinnersley, W. M.; Torrence, R. J. Phys. Lett.; 31A: 576-7(18 May 1970).

The nonlinear corrections to a nonsingular retarded-minus-advanced pulse of linearized quadrupole gravitational radiation are investigated. The second-order field is nonsingular if and only if there is no scattering of the radiation. Radiation scattering must appear in third order. (auth)

33046 ENERGY-MOMENTUM OF A CLOSED STATIC SYSTEM IN GENERAL RELATIVITY E = 0?. Folomeshkin, V. N. (Inst. for High Energy Physics, Serpukhov, USSR). Acta Phys. Pol.; B1: 13-15(1970).

It is shown that the standard expression for the total mass M of a closed static system in the form of the volume integral of canonical energy-momentum complex using the covariant quantity R as Lagrangian leads to the equality $M = M_s/2$, where M_s—Schwarzschild mass of the system. It follows that either the expression for the complex is inconsistent with the field equations or the "total" mass of the system is different from Schwarzschild mass, or M = 0. There are some ideas given that favor the possibility of M = 0. (auth)

33047 CANCELLATION OF INFRARED DIVERGENCES IN S-MATRIX AMPLITUDES. Enflo, B. O. (Univ. of Stockholm). Nuovo Cim.; 67A: 595-612(21 Jun 1970).

Unitarity and connectedness structure of the S-matrix are applied to photon processes. Amplitudes are constructed, which do not have the infra-red divergences of Feynman diagrams. Agreement with conventional perturbation theory results is shown in a case where the two methods are commensurable. (auth)

33048 TOPICS ON SPACE–TIMES. Lichnerowicz, Andre (College de France, Paris). pp 107-16 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

A survey of space-times is given. Orientations, the Cauchy problem for Einstein field equations, completeness and global hyperbolic manifolds, and spin structure are treated. (J.F.P.)

33049 STRUCTURE OF SPACE–TIME. Penrose, R. (Cornell Univ., Ithaca, N. Y.). pp 121-235 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

The treatment of space–time covers the nature of general relativity, abstract index notation, space–times with spinor structure, the interpretation of a spin vector, and explicit curvature formulas. Also covered are Einstein's equations and focusing, conformal infinity, horizons, gravitational collapse, and singularities in cosmology. (J.F.P.)

33050 STRUCTURE OF SINGULARITIES. Geroch, Robert (Princeton Univ., N. J.). pp 236-41 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

The structure of singularities in general relativity is discussed. An outline is given of an approach for bridging the gap between geodesic incompleteness on the one hand and the physical idea of a singularity as a point on the other. A construction is described by which given any incomplete space–time the requisite singular points can be defined and their local properties described. (J.F.P.)

33051 SUPERSPACE AND THE NATURE OF QUANTUM GEOMETRODYNAMICS. Wheeler, John Archibald (Princeton Univ., N. J.). pp 242-307 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

The discussion of superspace and quantum geometrodynamics includes history selected from dynamics by constructive interference, electricity as lines of force trapped in the topology of space, the energy of the vacuum, and a particle as a geometrodynamical exciton. The problems of the derivation of the Einstein–Hamilton–Jacobi equation, the structure of superspace, and initial conditions are studied. (J.F.P.)

33052 BOUNDARY CONDITIONS FOR THE STATE FUNCTIONAL IN QUANTUM THEORY OF GRAVITY. Leutwyler, H. (Univ., Bern). pp 309-17 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

The functional representation of the quantum theory of gravity is considered. The functional differential equations, the weak-field model, boundary condition and explicit solution of the weak-field model, superspace, and stationary phase approximations are presented. (J.F.P.)

Scattering Theory

33053 (UCRL–19795) THE TRIPLE–REGGE VERTEX. Misheloff, Michael Norman (California Univ., Berkeley. Lawrence Radiation Lab.). 28 Apr 1970. Contract W-7405-eng-48. 54p. Dep. CFSTI.

Thesis.

A Reggeized model is developed for the 3-to-3 amplitude using group theoretical variables. The triple-Regge vertex is defined by the asymptotic form of the amplitude. It is defined entirely in terms of physical region quantities and therefore is, in principle, directly measurable. (auth)

33054 DENSITY MATRICES IN THE MANY-BODY PROBLEM: CONNECTION WITH SCATTERING THEORY. Gluck, P. (Bar-Ilan Univ., Ramat-Gan, Israel). Phys. Rev., D; 1: 390-3(15 Jan 1970).

The energy per particle in a many-particle system, both for bosons and fermions, is discussed using a perturbation method and some results on reduced density matrices obtained previously. The theory is tested for hard-sphere Lennard–Jones, and non-singular potentials; it exhibits clearly the difficulties in going to higher-order approximations and gives results which correspond to those obtained by other methods. (auth)

33055 PROBLEM OF EXISTENCE OF A SCATTERING S MATRIX. II. Rayski, J. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B1: 31-6(1970).

It is shown that the S-operator cannot exist, but it is possible to define probabilities in momentum space by a careful transition to the limit. Our construction is quite independent of any asymptotic conditions upon the ingoing and outgoing fields. (auth)

33056 OPTICAL THEOREM FOR PARTIALLY POLARIZED PARTICLES. Bialkowski, G. (Univ., Warsaw). Acta Phys. Pol.; B1: 77-80(1970).

The optical theorem for partially polarized particles is derived in its most general form. It is shown that it can be used to determine experimentally the imaginary part of all spin amplitudes nonvanishing in the forward direction. (auth)

33057 EXACT SOLUTION OF A FAMILY OF INTEGRAL EQUATIONS OF ANISOTROPIC SCATTERING. Kagiwada, H.; Kalaba, R. (Univ. of Southern California, Los Angeles). J. Math. Phys. (N. Y.); 11: 1575-8(May 1970).

It is shown that the solution of a certain Cauchy system provides the solution of a family of integral equations occurring in the theory of anisotropic scattering in a finite slab. Numerical experiments show that the Cauchy system is readily solved numerically, even in the case of very strong forward scattering. (auth)

33058 EXACT SOLUTION OF A FAMILY OF MATRIX INTEGRAL EQUATIONS FOR MULTIPLY SCATTERED PARTIALLY POLARIZED RADIATION. II. Buell, June; Casti, John; Kalaba, Robert, Ueno, Sueo (Univ. of Southern California, Los Angeles). J. Math. Phys. (N. Y.); 11: 1673-8(May 1970).

In the theory of multiply scattered partially polarized radiation, a key role is played by the integral equation $J(t,x,z) = Ie^{-(x-t)/z} + \int_0^x K(|t-y|)J(y,x,z)\,dy$, $0 \le t \le x$, where J and K are square matrices, I is the unit matrix, z is a parameter lying in the interval (0,1), and for the interval length x, $0 \le x \le x_1$. It is shown that this family of matrix integral equations can be transformed into a Cauchy problem that is readily solved by modern computing machines. (auth)

33059 PERTURBATION THEORY, FINITE-ENERGY SUM RULES AND A GENERALIZED VENEZIANO REPRESENTATION. Matveev, V. A.; Stoyanov, D. T.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett.; 32B: 61-4 (25 May 1970).

The problem of the derivation of the Veneziano type representation is considered on the basis of an auxiliary integral parametric representation of scattering amplitudes satisfying unsubtracted dispersion relations. (auth)

33060 S MATRIX IN THE HEISENBERG REPRESENTATION. Borie, Edith Frances. Chapel Hill, N. C.; Univ. of North Carolina (1969). 48p.

Thesis.

The elements of the S matrix are calculated directly from an operator formalism, using a generalization of a method due to Yang and Feldman. This has the advantage that noncausal chains never appear in the radiative corrections, and hence do not have to be explicitly removed in order to maintain unitarity. A condensed notation due to DeWitt is used. The one and two loop contributions to the single quantum production amplitude, and the one loop contribution to the amplitudes for pair production and scattering of a single particle by the classical background field are calculated in the absence of an invariance group, and the results are found to agree with those of others. Finally, these results are generalized to the case in which an invariance group is present. It is found that the amplitudes are now expressed in terms of a noncovariant propagator which propagates physical quanta only. Rewriting these expressions in terms of covarfant propagators leads to the formal appearance of "fictitious quanta" which compensate the nonphysical modes carried by the covariant propagators. (Diss. Abstr.)

33061 LANDAU SINGULARITIES IN THE PHYSICAL REGION. Pham, Frederic (CERN, Geneva). pp 420-32 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, inc. (1968).

It is shown that for real momenta in the physical region, the Landau singularities are rather simple geometrical objects which can be introduced directly by purely kinematical considerations and therefore should play an important role in any reasonable theory of elementary processes, whatever the dynamical content of such a theory is. The geometric objects, Landau singularities, are introduced and their properties studied. Also the physical meaning of Landau singularities and their role in theories of elementary processes are discussed. (J.F.P.)

33062 ALGEBRAIC TOPOLOGY METHODS IN THE THEORY OF FEYNMAN RELATIVISTIC AMPLITUDES. Regge, Tullio (International Centre for Theoretical Physics, Trieste, Italy). pp 433-58 of Battelle Rencontres. /DeWitt, Cecile M. (ed.). New York; W. A. Benjamin, Inc. (1968).

The study of algebraic topology methods in the theory of Feynman relativistic amplitudes covers some technicalities of the study, the Grassman algebra of exterior forms in the differentials, the derivation of some differential equations, and the difficulties and complications of Feynman relativistic amplitudes with $l > 1$. (J.F.P.)

33063 OPERATOR REDUCTION OF THREE-BODY SCATTERING EQUATIONS. Kazaks, P. A.; Greider, K. R. (Univ. of California, Davis). Phys. Rev., C; 1: 856-64(Mar 1970).

Operator multipliers of the Lippmann–Schwinger (LS) equation are used to obtain an uncoupled equation with calculable and unique solutions. The multiplier method is used as a basis for determining the relation between various formulations of the three-body problem. The formal but calculable solutions of the formulations of Faddeev, Lovelace, Rosenberg, Noble, and Newton are found to be identical in the sense that the different formulations are completely equivalent because they all use the same multiplier. They are also identical to the solution of the equation obtained by multiplying the L–S equation by an operator whose inverse exists. An equation for the exact three-body bound-state wave function is presented and put into calculable form with the use of a multiplier. In a calculation that uses an incomplete set of basis states (such as in the shell model), on rigorous grounds it is found to be appropriate to use the t operator of the residual interaction rather than the residual interaction itself. To indicate the wide usefulness of the multiplier method, the exact distorted-wave formulation is obtained and put into calculable form with the use of a multiplier. (auth)

33064 MULTIPERIPHERAL DYNAMICS AT NONVANISHING VALUES OF MOMENTUM TRANSFER. Mueller, A. H. (Brookhaven National Lab., Upton, N. Y.); Muzinich, I. J. Ann. Phys. (N. Y.); 57: 500-24(Apr 1970).

The equation for the absorptive part of the forward elastic scattering amplitude derived by Chew and De Tar as a quadrature on the manifold of the Lorentz group is generalized to include the nonforward absorptive part. An integral equation is derived which is diagonalized by expansion into the irreducible representations of the subgroup of the homogeneous Lorentz group, SO(2, 1). Explicit calculations of the irreducible representations of SO(2, 1) or its covering SU(1, 1) with respect to a noncompact basis O(1, 1) are presented in detail. (auth)

Particle Accelerators

Refer also to abstracts 32494 and 33108.

33065 (IFVE-ORE-69-76) INDUCED RADIOACTIVITY AT THE PROTON SYNCHROTRON OF THE INSTITUTE OF HIGH ENERGY PHYSICS. Golovachik, V. T.; Britvich, G. I.; Lebedev, V. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov, Institut Fiziki Vysokikh Energii). 1969. 17p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The results of experimental investigations of the induced radioactivity on the 70 GeV proton synchrotron are presented including induced radioactivity spectra, space–time distributions, and component composition of radiation. The β-radiation contributions are estimated. (auth)

33066 (ITEF-738) CONCERNING THE CHOICE OF THE SCHEME AND THE MAIN PARAMETERS OF THE ITEP BOOSTER. Plotnikov, V. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1969. 46p. (In Russian). Dep. CFSTI (U. S. Sales Only).

The choice of the scheme and the main parameters of the booster are considered. It is shown that to increase the intensity of the ITEP proton synchrotron up to $(5 \text{ to } 10) \cdot 10^{12}$ particles per pulse, both fast and slow boosters may be used. The main parameters of two variations of fast boosters (with the length of the equilibrium orbit 26 and 31 m) and of one slow booster (with the length of the orbit 62.5 m) are found. The parameters of the accelerating and magnet systems and some characteristics of particle motion for all three variations of boosters are estimated. Virtues and defects of fast and slow boosters are given. (auth)

33067 (ITEF-739) CONCERNING THE EFFECTIVENESS OF MULTITURN INJECTION. Plotnikov, V. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1969. 24p. (In Russian). Dep. CFSTI (U. S. Sales Only).

Multiturn particle injection into the ring accelerator by filling the phase volume of transversal motion is considered. The effective injection for the method of different frequencies and the resonance method is calculated. (auth)

33068 (KFK-tr-314) CALCULATION OF MAGNETIC FIELDS IN MAGNETS WITH GAPS. Papadichev, V. A. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). Translated by Rosemarie Corssen (Kernforschungszentrum, Karlsruhe, W. Ger.), from Preprint No. 69. 21p. (In German). Dep. CFSTI (U. S. Sales Only).

A method for the calculation of the magnetic field in magnets with gaps was derived at various pole excitations. The results

can be used for the calculation of the fields of isochronouscyclotrons, ring phasotrons, and for consideration of the boundary effects. The coefficients of the Fourier series development were calculated for the periodic structures. The results were compared with experiment. (tr-auth)

33069 (NP-18226) REVIEW ON THE SURVEYING OF CIRCULAR ACCELERATORS AND A PROPOSAL FOR A SYSTEM FOR THE KARLSRUHE PROTON SYNCHROTRON PROJECT. Krafft, Gerd (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Dec 1969. 47p. (In German). Dep. CFSTI (U. S. Sales Only).

The precision placement of the magnets for the Karlsruhe proton synchrotron is considered. The selection of the measurement system was determined essentially by a machine with a CR (combined function) structure. Some general viewpoints on the selection of a measurement system for the placement of magnets are outlined. A brief review is given of measurement systems used in existing or planned accelerators. A comparison of the various methods for the vertical and horizontal placement of the magnets is made with respect to the Karlsruhe project. The differing effects of placement errors on the closed orbit in a CF structure and an SF machine are treated. The method proposed for the Karlsruhe proton synchrotron is then described. (tr-auth)

33070 (NP-18227) EXPERIMENTS ON PARTICLE-FIELD INTERACTIONS IN A SUPERCONDUCTING PROTON LINEAR ACCELERATOR. Mittag, Karl (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Dec 1969. 70p. (In German). Dep. CFSTI (U. S. Sales Only).

Thesis. Submitted to Karlsruhe Univ., Ger.

Mechanisms of possible particle-field interactions are explained in detail. A theoretical description for the longitudinal and one for the transverse particle-field interactions are outlined. The experimental arrangement is described. Experiments on the determination of structure properties and on the excitation of acceleration modes and decay modes by the particle beam are described. The consequences of these experimental results on the structure of a superconducting proton linear accelerator are considered. (tr-auth)

33071 (RISO-M-1241) ESTIMATE OF DOSES AT THE CERN PROTON SYNCHROTRON. Bjergbakke, E.; Carlsson, C. (Danish Atomic Energy Commission, Risoe. Research Establishment). Apr 1970. 15p. Dep. CFSTI (U. S. Sales Only).

Preliminary radiation dose data for low-Z materials in the immediate environment of the CERN proton synchrotron are presented. Dose data for scattered radiation from a copper target bombarded by 24 GeV protons and a beryllium target bombarded by 12 GeV protons are included. The various dosimeters used are briefly discussed. (W.H.K.)

33072 ION OPTICS OF A HEAVY ION ACCELERATOR. Grilli, E.; Sona, P. G. (CISE, Milan. Univ., Milan). Energ. Nucl. (Milan); 17: 317-19(May 1970).

Some results are given for the ion optics of a heavy ion cyclic accelerator with static fields (tandem Van de Graaff) only recently proposed. Also other problems of the accelerator are considered. (auth)

33073 THICK-TARGET BREMSSTRAHLUNG PRODUCED BY ELECTRON BOMBARDMENT OF TARGETS OF Be, Sn, AND Au IN THE ENERGY RANGE 0.2 TO 2.8 MeV. Rester, D. H. (Ling-Temco-Vought, Inc., Dallas); Dance, W. E.; Derrickson, J. H. J. Appl. Phys.; 41: 2682-92(May 1970).

Electron bremsstrahlung due to bombardment of Sn and Au targets at 0.2, 1.0, 2.0, and 2.8 MeV, Be targets at 0.2, 1.0, and 2.0 MeV, and Al and Fe targets at 0.2 MeV was measured. Angular distributions of bremsstrahlung intensity and total transmission spectra are derived from the measurements, which were carried out for perpendicular incidence of the electron beam to the target plane. Comparisons for Au and for previously reported Al and Fe spectra are made at 1.0 and 2.8 MeV to calculated spectra from the Monte Carlo program of M. J. Berger and S. M. Seltzer, ETRAN 15. Total external radiation emitted from the targets is represented by the function $1.4 \times 10^{-3}\ T_0^{1.16}$ for Be, $1.6 \times 10^{-2}\ T_0^{1.07}$ for Sn, and $2.3 \times 10^{-2}\ T_0^{1.90}$ for Au, where T_0 is the incident electron kinetic energy in MeV. (auth)

33074 SPATIAL DEPENDENCE OF THE BREMSSTRAHLUNG CHARACTERISTICS OF LINAC AND ITS EFFECTS ON PHOTONUCLEAR ACTIVATION. Miki, Ryota (Kinki Univ., Osaka); Kondo, Yoshihide; Azuma, Toshio. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 60-2(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The spatial dependence of the bremsstrahlung energy from a gold target bombarded by a 16-MeV electron beam was studied. A stacked-foil activation detector was used. Results are presented. (W.H.K.)

33075 NONDESTRUCTIVE TESTING WITH THE ELECTRON LINAC. Fujita, Hyota; Akiba, Toshimitsu; Irie, Keichi; Suzuki, Toshimitsu; Uetomi, Isamu; Ueda, Kojyu; Minowa, Yoshibumi (Mitsubishi Electric Corp., Amagasaki, Japan). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 63-5(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The steel exposure curve and steel wire sensitivity of the ML-15R electron linac x-ray source are presented graphically. The linac x-ray source is briefly described. (W.H.K.)

33076 MEASUREMENT OF NEUTRONS FROM 32 MeV MEDICAL BETATRON. Fukuda, Masai; Onoyama, Yasuto; Kimura, Ikuo; Nishidai, Takehiro; Mukai, Takao (Kyoto Univ.). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 140-2(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The neutron dose and flux distributions in a 32-MeV betatron radiotherapy room were measured using a long counter, indium-115 activation foils, and a NaI scintillation detector. Results of the measurements and problems encountered are discussed. (W.H.K.)

33077 OPERATING CHARACTERISTICS OF 300 KeV, 30 mA ELECTRON ACCELERATOR. Arakawa, K. (Matsushita Electric Industrial Co., Ltd., Japan); Inoue, T.; Kanamori, T. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 479-82(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

Characteristics of an industrial scanning electron accelerator are briefly described. The circuit of the dc high voltage generator is shown and the electron beam penetration curve is graphed. (W.H.K.)

33078 MEDICAL CYCLOTRON AND REACTOR. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 885-906(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A brief discussion is given on the medical cyclotron, concept of medical reactors, application of linac booster to medicine and biology, medical application of reactors, and analysis of the current status of applications of the medical cyclotron and reactors in Western countries. (W.H.K.)

33079 INTENSE 14-MeV NEUTRON SOURCE. Jobst, J. E. (Edgarton, Germeshausen and Grier, Las Vegas, Nev.). Trans. Amer. Nucl. Soc.; 13: 81(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 31730, 33079, and 33124.

33080 (GA-9901) INTEGRAL NEUTRON THERMALIZATION. Quarterly Progress Report, October 1–December 31, 1969. Slaggie, E. L.; Borgonovi, G. M.; Houston, D. H.; Neill, J. M. (Gulf General Atomic, Inc., San Diego, Calif.). 7 Jan 1970. Contract AT(04-3)-167. 18p. Dep. CFSTI.

Research progress on integral neutron thermalization studies is reported. The studies include use of the FLANGE I and FLANGE II codes for extracting data from the ENDFIB file, spectrum measurements of plutonium nitrate, energy mesh selection and thermal benchmark calculations, and ENDF-related activities. (J.W.R.)

33081 (JUL-632-MA) PROBLEM OF THE EIGENVALUE OF THE NEUTRON TRANSPORT EQUATION. Ebersoldt, Franz (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Angewandte Mathematik). Dec 1969. 30p. (In German). Dep. CFSTI (U. S. Sales Only).

The essential spectral properties of the linear Boltzmann operator B were united to a partial space of the complex L_2. The eigenvalue problem $B\phi = \lambda\phi$ for a finite body with complex envelope in which no particles enter from outside was studied. The results were compared for the special cases of the monoenergetic isotropic neutron transport in an infinite plate (plane problem) and in thermalization in finite media. Criteria for the existence of eigenvalues were given. (tr-auth)

33082 (JUL-634-MA) SOLUTION OF THE STATIONARY NEUTRON TRANSPORT EQUATION WITH SPHERICAL SYMMETRY. Hanke, W.; Horlitz, E.; Petry, W. (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Angewandte Mathematik). Dec 1969. 22p. (In German). Dep. CFSTI (U. S. Sales Only).

The spherical symmetric form of the general stationary neutron transport equation with certain boundary conditions was transformed into a Fredholm integral equation of the second type. Existence principles, exclusion principles and an iteration method for the solution were given. For the case of forward scattering, the discrete problem was discussed. Several examples were calculated. (J.S.R.)

33083 YIELDS AND SPECTRA OF SOME SPHERICAL PHOTONEUTRON SOURCES. Bensch, F.; Vesely, F. J. Nucl. Energy; 24: 57(Feb 1970).

A number of significant corrections are listed, relating to the article "Yields and Spectra of Some Spherical Photoneutron Sources," by F. Bensch and F. Vesely. [J. Nucl. Energy, 23: 537-50(Nov. 1969)]. (UK)

33084 SOLVING THE TRANSPORT EQUATION OF MONOENERGETIC NEUTRONS WITH LINEAR ANISOTROPIC DIFFUSION IN THE PLANE NON-STATIONARY CASE. Draganu, M. Rev. Roum. Math. Pures Appl.; 14: 629-36(1969).

A solution of the transport monoenergetic neutrons is obtained for the case of linear anisotropic diffusion when the source distribution assumes the form $\frac{1}{2}\,\delta(t - t_0)\,\delta(x - x_0)\,\delta(\mu - \mu_0)$ by Papmehl's method. The source distribution considered makes the solution closely related to Green's function. (Rom. Sci. Abstr.)

33085 THE SPECTRUM OF DISCRETE EIGENVALUES AND THE EIGENFUNCTIONS OF THE STATIONARY AND TIME-DEPENDENT NEUTRON TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING. Meister, G. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie; 15: 109-14(1970).

The results of an investigation on properties of the solution of the monoenergetic neutron transport equation with an arbitrary scattering kernel are presented. Time dependent as well as stationary problems with isotropic fission sources are taken into consideration. The investigation is based on the representation of the solution as an expansion in discrete and continuous eigenfunctions, being first introduced by Case for isotropic scattering. The eigenvalue spectra for anisotropic scattering which, in contrast to the isotropic case, have essentially different features for stationary and time-dependent problems are interpreted from a general point of view. The consequences of anisotropy especially with regard to the space-time-behavior of neutron density in time dependent problems are discussed. (auth)

33086 SEMIANALYTICAL SOLUTION OF THE ENERGY-DEPENDENT BOLTZMANN EQUATION IN PLANE GEOMETRY. Freund, Hans-Dieter (Christian Albrechts Univ., Kiel). Atomkernenergie; 15: 115-18(1970). (In German).

The structure of the solution is formed such that the numerical computation can easily be made by electronic computers. The starting-point is a group approximation with isotropic scattering in the laboratory system. The energy-dependent Boltzmann equation changes into a coupled system of unhomogeneous, one-velocity integro-differential equations. Therein the unhomogeneous terms describe the neutron sources in consequence of scattering and multiplication processes. The general solution of the neutron flux in each group is the sum of the Case-solution and the particular solution of the unhomogeneous term. If the latter is an exponential or trigonometric function you will find an analytical expression for the particular integral. In arbitrary source distributions a Fourier expansion leads again to trigonometric functions. With such an expansion the same solution function can be specified for all energy groups. The Fourier coefficients, included in the solution, are determined by iteration techniques of the sources. (auth)

33087 SIMULATED THERMALIZATION OF A NEUTRON BURST. Mueller, K.-H. (CCR-EURATOM, Ispra, Italy). Atomkernenergie; 15: 119-21(1970).

The decay of a monoenergetic point burst of 0.45 eV starting at the center of a sphere and the subsequent approach to thermal equilibrium for a free-gas scattering model was stochastically simulated. The space-time dependent energy spectra in small and big spheres were calculated. The difference in spectral behavior between the leakage and central zone is very strong in the case of small spheres but decreases as the radius increases. (auth)

33088 STANDARD FAST NEUTRON SPECTRA. Profio, A. E. (Univ. of California, Santa Barbara). Trans. Amer. Nucl. Soc.: 13: 259(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33089 EXPERIMENTAL AND ANALYTICAL STUDIES OF FAST NEUTRON SPECTRA IN IRON. Malaviya, B. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc.; 13: 259-60(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33090 NEUTRON TRANSPORT MEASUREMENTS IN IRON. Cerbone, R. J. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 260(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33091 NEUTRON TRANSPORT IN IRON. Mynatt, F. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 260(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33092 ONE-DIMENSIONAL S_n CALCULATIONS OF NEUTRON SPECTRA REFLECTED FROM THICK SLABS OF CONCRETE AND IRON, COMPARISON WITH MEASUREMENTS. Meyer, Walter (Kansas State Univ., Manhattan); Timmons, Darrol H.; Shen, Peter K. Trans. Amer. Nucl. Soc.; 13: 261-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33093 SURVEY OF THEORETICAL STUDIES AT COLUMBIA UNIVERSITY ON FAST NEUTRON TRANSPORT IN IRON. Goldstein, Herbert (Columbia Univ., New York). Trans. Amer. Nucl. Soc.; 13: 262(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33094 MEASUREMENTS AND ANALYSIS OF INTEGRAL NEUTRON SPECTRA PRODUCED BY 14-MeV NEUTRONS. Hansen, Luisa F. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 13: 262-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33095 NEUTRON SPECTRUM MEASUREMENTS IN LIQUID NITROGEN. Harris, R. J. Jr. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 263-4(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33096 ENERGY AND ANGULAR DISTRIBUTION OF NEUTRONS EMERGING FROM THE HENRE TARGETS. Burson, Zolin G. (Edgarton Germeshausen and Grier, Las Vegas, Nev.). Trans. Amer. Nucl. Soc.; 13: 265(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33097 QUASI-MONOENERGETIC FAST-NEUTRON PULSE PROPAGATION IN IRON. Napolitano, C. M.; Carroll, E. E.; Ohanian, M. J. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 13: 275-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33098 PARAMETERIZATION OF SPECTRUM-AVERAGED THERMAL CROSS SECTIONS. Karin, Sidney; Zweifel, P. F.; Jones, Richard B. (Edlund-Shure-Zweifel, Ann Arbor, Mich.). Trans. Amer. Nucl. Soc.; 13: 306(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33099 SMALL SAMPLE SCATTERING AS AN INTEGRAL CHECK ON THE NEUTRON SCATTERING CROSS SECTIONS. Kaushal, N. N.; Golay, M. W.; Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc.; 13: 309(Jun-Jul 1970).
From American NuclearSociety Meeting, Los Angeles, Calif. See CONF-700608.

33100 NEUTRON CROSS-SECTION DATA SYSTEM FOR PROCESSING ENDF/B TAPES. Green, I. D.; Roy, D. H. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 13: 315-16(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33101 EVALUATION BY SIMULATION OF A NEW TECHNIQUE FOR DIFFERENTIAL NEUTRON CROSS-SECTION MEASUREMENTS. Cofer, H. G. (Westinghouse Electric Corp., Pittsburgh); Ohanian, M. J. Trans. Amer. Nucl. Soc.; 13: 316-17(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33102 NUCLEAR CROSS SECTIONS: MULTIGROUP REPRESENTATION OF NEUTRON CROSS SECTIONS FOR CRITICALITY CALCULATIONS. Hansen, Gordon E. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 13: 392-3(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33103 METHOD FOR TESTING NEUTRON CROSS SECTIONS AND NEUTRONICS COMPUTER PROGRAMS BY COMPARISON WITH INTEGRAL NEUTRON EXPERIMENTS. Hampel, Viktor E. (Univ. of California, Livermore). Trans. Amer. Nucl. Soc.; 13: 393-4(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33104 TAILORED SPECTRA FOR INTEGRAL CROSS-SECTION MEASUREMENTS IN THE REGION BELOW 100 keV. Draper, E. Linn Jr. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 13: 397-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33105 RECONSTRUCTION OF NEUTRON SPATIAL DISTRIBUTIONS FROM SPATIAL MOMENTS. Soran, Patrick; Goldstein, Herbert (Columbia Univ., New York). Trans. Amer. Nucl. Soc.; 13: 405(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33106 CALCULATION OF NEUTRON LIFETIMES. Lewins, Jeffery (University Coll., London). Nucl. Sci. Eng.; 40: 361 (May 1970).
Some features in the variational calculation of neutron lifetimes are discussed. (J.W.R.)

33107 PREDICTIONS FOR NEUTRON TRANSPORT IN AIR, BASED ON INTEGRAL MEASUREMENTS IN NITROGEN AND OXYGEN AT 14 MeV. Hansen, L. F.; Anderson, J. D.; Goldberg, E.; Kammerdiener, J.; Plechaty, E.; Wong, C. (Univ. of California, Livermore). Nucl. Sci. Eng.; 40: 262-82(May 1970).
Using the sphere transmission and time-of-flight techniques, the neutron spectra emitted from 0.58 and 3.0 mfp of nitrogen and from 0.72 mfp of oxygen were measured for a 14-MeV neutron source. The analysis of the data was done using the Livermore Monte Carlo Neutron-Transport Program (SORS). Good agreement was obtained for nitrogen with a revised SORS calculation, where five inelastic levels are explicitly included in the computational routine for the (n,n') cross sections. To obtain agreement between calculations and measurements for oxygen, the computational model had to be extended so that it could account for the presence of inelastic levels. A revision of the cross sections was also carried out. With these new versions of SORS, excellent fits to the experimental measurements for nitrogen and oxygen were obtained. Using the revised SORS program, calculations for the transport of neutrons in air from a 14-MeV point neutron source were obtained. (auth)

Nuclear Properties and Reactions, A≤5

Refer also to abstract 33116.

33108 $^{2}H(^{6}Li,^{4}He)^{4}He$-REACTION WITH POLARIZED LITHIUM NUCLEI AND CONSERVATION OF NUCLEAR POLARIZATION AT SURFACE IONISATION. Holm, U.; Steffens, E.; Albrecht, H.; Ebinghaus, H.; Neuert, H. (Univ., Hamburg). Z. Phys.; 233: 415-21(1970). (In German).
The polarization of polarized lithium ions from an atomic beam source was measured by the $^{2}H(^{6}Li,^{4}He)^{4}He$-reaction at 600 keV lithium energy. The tensor polarization was found to be about 0.7, reaching 70% of the maximum value. The polarized atomic beam was ionized by a hot tungsten surface. Surface ionization seems not to disturb nuclear polarization. (auth)

33109 ELASTIC SCATTERING OF NEUTRONS BY DEUTERONS. Purkayastha, Gita; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 43: 335-43(Jun 1969).
The elastic scattering of neutron by deuteron was investigated considering the exchange collision possibility. A modification of the Born approximation due to Dirac which takes account of the nonorthogonality of the initial and final wave functions was used. The resulting integral equations were solved by the Fredholm method. The calculations were done for energies of 60, 95, and 146 MeV of the incident neutrons. The results of the numerical calculation at 95 MeV are in good agreement with the experimental findings as well as the theoretical results of Wu & Ashkin. The nonorthogonality corrections are quite perceptible at lower energies but small at high energy. (auth)

33110 EFFECTIVE FORCES AND THREE BODY PROBLEM IN NUCLEAR PHYSICS. Dzhibuti, R. I.; Krupennikova, N. B. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz.; 11: 355-60 (Feb 1970). (In Russian).
The binding energy, Coulomb energy (nuclear radius), integral cross section of dipole photoabsorption, and the cross section of the total photosplitting of the ^{3}He nucleus were calculated using a new nonlocal nucleon-nucleon potential with separable variables and based on the one-parameter Irving function. Results obtained are in good agreement with the experiment. (auth)

Nuclear Properties and Reactions, 6≤A≤19

Refer also to abstract 31362.

33111 (CONF-680461-10) ELASTIC AND INELASTIC SCATTERING OF POLARIZED PROTONS IN ^{11}B IN THE ZONE OF THE GIANT RESONANCE. Salzborn, E.; Clausnitzer, G. (Erlangen-Nuernberg Univ. (West Germany). Physikalisches Institut). [nd]. 12p. (In German). Dep. CFSTI (U. S. Sales Only).
From German-Netherlands Conference on Nuclear Physics, Bad Neuenahr, Germany.
^{11}B was bombarded with polarized protons and the elastic scattering, the inelastic scattering on the first excited level of ^{11}B, and the $^{11}B(p,\alpha_0)^{8}Be$ reaction in some selected energy regions were investigated. The results obtained are shown graphically: a typical spectrum, an excitation function for the differential cross section in elastic proton scattering, the inelastic scattering of protons, the coefficients of the Legendre polynomial up to a_5, and the results of a particle-hole calculation for ^{12}C. (J.S.R.)

33112 SCATTERED CROSS-SECTIONS OF 14 MeV NEUTRONS. Azuma, Toshio (Radiation Center of Osaka Prefecture); Sato, Yuji; Kuwajima, Kaneomi. Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 56(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

The angular distributions and cross sections for the elastic and inelastic scattering of 14-MeV neutrons on ^{12}C, ^{16}O, ^{27}Al, ^{56}Fe, and ^{208}Pb were measured. The inelastic cross sections were compared with Hauser–Feshbach calculations. (J.W.R.)

33113 TABLE OF SPECIFIC GAMMA RAY CONSTANTS. Nachtigall, Dieter. Thiemig Taschenbuecher, Band 34. Munich; Verlag Karl Thiemig KG (1969). 108p. DM 9.80. (In several languages).

The specific γ-ray constants for about 700 γ-emitting nuclides were calculated using the latest available experimental data. The decay constants, half-lives, γ energies, and emission probabilities are tabulated. (J.W.R.)

33114 REACTIONS $^{16}O(d,p_1)^{17}O^*$, AND $^{16}O(d,p_0)^{17}O$. MEASUREMENT OF THE EXCITATION FUNCTION BETWEEN E_d = 350 AND 1050 keV. ANGULAR DISTRIBUTIONS. Dumont, P. D. (Univ., Liege); Huez, M. Bull. Soc. Roy. Sci. Liege; 38: 516-22 (1969). (In French).

The excitation function of the $^{16}O(d,p_1)^{17}O^*$ reaction was measured at $\theta = 154°$ for 350 keV $\leq E_d \leq$ 1050 keV. The angular distributions were measured from 64° up to 154°. For the $^{16}O(d,p_0)$ reaction, the deuteron energy domain was 450 keV $\leq E_d \leq$ 950 keV. For the $^{16}O(d,p_1)$ reaction, the deuteron energy domain was 450 keV $\leq E_d \leq$ 1050 keV. (auth)

33115 STUDY OF THE MECHANISM OF THREE ALPHA PARTICLE EMISSION IN THE REACTION $^{11}B(p,3\alpha)$ AT 1.98 MeV AND $^{10}B(d,3\alpha)$ AT 1 MeV. Paviot, N.; Berrada, M.; Frois, B.; Marquez, L.; Quebert, J.; Scheurer, N. (Bordeaux Univ.). J. Phys. (Paris); 31: 35-9(Jan 1970). (In French).

The hypothesis of a $J^\pi = 0^+$ state of ^{12}C in $^{11}B(p,3\alpha)$ at 1.98 MeV is in agreement with the observed coincidence spectra. The $^{10}B(d,3\alpha)$ reaction does not appear to be sensitive to a spin effect of a ^{12}C state. In both reactions we can observe a lowering of the density on the edge of the Dalitz plot. (auth) (France)

33116 STUDY OF THE p + ^{3}H AND n + ^{3}He FINAL-STATE INTERACTIONS IN THE REACTIONS $^7Li(p,\alpha)$ AND $D(^3He,p)$. Lin, Wen Kuan. Pasadena, Calif.; California Inst. of Tech. (1969). 154p.

Thesis.

The α-particle energy spectra from the bombardment of ^{7}Li with 9.1-MeV protons were obtained at $2.5° \leq \theta_\alpha \leq 120°$. The high-energy ends of the spectra are interpreted as due to the ^1S p + ^{3}H final-state interaction through the first excited state of ^{4}He at 20.06 MeV. The factored-wave-function method is used to deduce the resonance parameters of this state. Consistency in the use of this method is obtained by a PWBA calculation based on the triton-transfer mechanism to account for the forward-peaking in the angular distribution. Coincidence measurements between α-particles and the other charged particles give additional evidence for the 0^+ assignment to the state, and indicate that the α + ^{3}H and α + H final-state interactions are important as the ^{4}He excitation energy gets higher. To reduce the effects of the final-state interactions, the reaction $D(^3He,p)$, at a ^{3}He bombarding energy of 16.5 MeV, was investigated. The protons emitted from the reaction were measured at $\theta_p = 30°$ in coincidence with the other charged particles. Angular correlations were obtained for 6.6 MeV $\leq E_p \leq$ 8.6 MeV, and compared with a modified Born approximation calculation based on the stripping of ^{3}He. The angle-energy correlation and the p–^{3}H to p–^{3}He branching ratio can be reproduced, if Meyerhof's p + ^{3}H phase shifts and Bransden's n + ^{3}He phase shifts are used to describe their respective interactions in the final states. In agreement with the reported 0^- state at 21.2 MeV, the p-wave final-state interactions are found to be important in this energy range. (Disser. Abstr. Int., B)

33117 REACTION $^{19}F(d,\alpha)^{17}O$. Betigeri, M. G.; Lamba, C. M.; Sarma, N.; Sood, D. K.; Thampi, N. S. (Bhabha Atomic Research Centre, Bombay). Energ. Nucl. (Milan); 17: 256-61 (Apr 1970).

At an incident deuteron energy of 2.0 to 5.2 MeV, the excitation functions for the α-groups corresponding to the lowest three states of ^{17}O in the reaction $^{19}F(d,\alpha)^{17}O$ and the elastic scattering of deuterons on ^{19}F were studied. The excitation functions indicate the presence of very wide structures. The angular distributions off and on the resonances are measured. The correlation and Legendre polynomial analysis of the results indicate a high direct reaction component. The analysis of structures is attempted in terms of intermediate structures. (auth)

33118 QUASIFREE SCATTERING OF π^+ MESONS WITH ENERGY 117 MeV ON PROTONS IN LIGHT NUCLEI. Gismatullin, Yu. R.; Ostroumov, V. I. (Leningrad Polytechnic Inst.). Yadern. Fiz.; 11: 285-9(Feb 1970). (In Russian).

Reactions like $A(\pi^+,\pi^+p)B$ on light nuclei at the pion energy 117 MeV are investigated by means of the nuclear emulsion method. Differential and integral cross sections, momentum and angular distributions of residual nuclei are obtained. The validity of the pole approximation is tested applying the Treiman–Yang criterion. (auth)

33119 ELECTROPRODUCTION OF PIONS FROM COMPLEX NUCLEI. Titov, Yu. I.; Stepula, E. V.; Afanas'ev, N. G.; Akhmerov, R. V.; Byvalin, S. A.; Severin, N. F.; Smelov, E. M.; Yaroshevskii, L. D. (Physical-Technical Inst. of Low Temperatures, Kharkov). Yadern. Fiz.; 11: 260-5(Feb 1970). (In Russian).

Spectra of the electron inelastic scattering on C, Al, Ni, Mo, W nuclei are measured at initial energy 1178 MeV at an angle 35°. All the spectra have two maxima, one of which is due to quasielastic scattering of electrons on nucleons, and the second is due to the isobar Δ_{1236} production. The cross section per one nucleon in the electro-production maximum is the same within the errors for all nuclei and in the absolute value is close to the cross section on free nucleon. The cross section per one nucleon in the quasielastic scattering maximum with the account of different contribution from neutron and proton is also the same and reasonably described by the impulse approximation. (auth)

33120 STUDY OF REACTIONS $^{19}F(d,p)^{20}F$ AND $^{23}Na(d,p)^{24}Na$ IN THE ENERGY RANGE 2,5 TO 4,0 MeV. Zabegai, V. M.; Melenevskii, A. E.; Nemets, O. F.; Nemykin, V. N. (Inst. of Physics, Kiev). Yadern. Fiz.; 11: 277-84(Feb 1970). (In Russian).

Excitation functions for seven proton groups in $^{19}F(d,p)^{20}F$ and for four groups in $^{23}Na(d,p)^{24}Na$ were studied. Angular distributions were measured for nine different energy values. Averaged cross sections were described by the sum of the stripping process in the distorted wave approximation and compound-nucleus excitation. Values for spectroscopic factors for a series of levels were obtained. Mean lifetimes of compound systems were estimated. (auth)

33121 NEUTRON CROSS SECTIONS FOR AIR TRANSPORT. Young, P. G.; Foster, D. G. Jr. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 13: 262(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33122 ADAPTATION OF THE CORE-QUASI-PARTICLE COUPLING MODEL FOR NEUTRON CROSS-SECTION GENERATION AND ANALYSIS. Kumar, K.; Yost, K. J. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 311-12 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33123 HELIUM PRODUCTION CROSS SECTIONS FOR ELEMENTS IRRADIATED IN EBR-II. McElroy, W. N. (Battelle-Northwest, Richland, Wash.); Farrar IV, H.; Knox, C. H. Trans. Amer. Nucl. Soc.; 13: 314-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Nuclear Properties and Reactions, 20 ≤ A ≤ 89

Refer also to abstracts 33112, 33113, 33119, 33120, and 33123.

33124 DETERMINATION OF THE ENERGY DEPENDENCE OF THE $^{63}Cu(n,2n)^{62}Cu$ AND $^{27}Al(n,p)^{27}Mg$ CROSS SECTIONS, AND THEIR APPLICATION TO THE MEASUREMENT OF 14-MeV NEUTRON FLUXES. Partington, D.; Crumpton, D.; Hunt, S. E. (Univ. Aston, Birmingham, Eng.). Analyst; 95: 257-9(Mar 1970).

The variations in cross section of the $^{63}Cu(n,2n)^{62}Cu$ and the $^{27}Al(n,p)^{27}Mg$ reactions as a function of neutron energy were measured in the 13.5 to 14.9-MeV range, which is commonly used for 14-MeV neutron activation. The cross section of the $^{63}Cu(n,2n)^{62}Cu$ reaction was found to increase approximately linearly with a gradient of 140 ± 10 mb MeV^{-1}, and that of the $^{27}Al(n,p)^{27}Mg$ reaction was found to be approximately constant. It is therefore suggested that the $^{27}Al(n,p)^{27}Mg$ reaction is more suitable for measuring the numerical value of a 14-MeV neutron flux, in spite of its lower

cross section. It is also suggested that to obtain 14-MeV neutron activation measurements that are independent of neutron energy the energy dependence of the flux-measuring foil and irradiated specimen should be matched. The $^{27}Al(n,p)^{27}Mg$ reaction appears to be suitable for all (n,p) reactions, while the $^{63}Cu(n,2n)^{62}Cu$ reaction may be more suitable for (n,2n) reactions. (auth) (UK)

33125 NEUTRON DEPOLARIZATION IN ELASTIC SCATTERING. Katori, Kenji; Nagata, Tsugako; Uchida, Akira; Kobayashi, Shinsaku (Tokyo Univ.). J. Phys. Soc. Jap.; 28: 1116-27(May 1970).

The depolarization parameter $D(\theta)$ in elastic scattering of 1.36 MeV neutrons was measured at θ_2 = 30, 38, 80, 120 and 150° for ^{27}Al, ^{59}Co, ^{63}Cu, ^{65}Cu, ^{209}Bi and Ni nuclei. The departure of $D(\theta)$ from unity for Al, Co, Cu and Bi was observed particularly at backward angles, but not observed for Ni. This fact shows that the spin flip of incident neutrons takes place along the normal to the scattering plane in the elastic scattering process for non-zero spin targets. These results are discussed in the light of different nuclear reaction mechanisms. (auth)

33126 DECAY OF ^{78}Br. Dorikens, M.; Dorikens-Vanpraet, L.; Demuynck, J. (State Univ., Ghent). Z. Phys.; 233: 422-9 (1970).

The decay of ^{78}Br was investigated with a Ge(Li) spectrometer and Ge(Li)-NaI(Tl) coincidence methods. Accurate energy and intensity determinations of 14 gamma rays were performed. A level scheme with levels at 614.0, 1,308.1, 1,498.4, 1,758.5, 1,993.7, 2,334.4, 2,538, 3,090 and 3,253 keV is deduced. Spin and parity indications for most of the observed levels are given from electron capture and positron decay considerations and gamma branches. (auth)

33127 $\beta-\gamma$ (CP) CORRELATION MEASUREMENTS IN ^{59}Fe, ^{124}Sb, AND ^{103}Ru. Behrens, H.; Zernial, W. (Univ., Karlsruhe, Ger. Kernforschungszentrums, Karlsruhe, Ger.). Z. Phys.; 233: 458-70(1970). (In German).

The $\beta-\gamma$ circular polarization asymmetry for three nuclides has been measured using a special polarimeter developed at Karlsruhe. The results of the measurements are

Nuclide	A	Transition
^{59}Fe	-0.158 ± 0.007	β 0.47-γ 1.10 MeV
^{124}Sb	$+0.278 \pm 0.013$	β 0.62-γ 1.69 MeV
^{103}Ru	-0.107 ± 0.011	β 0.22-γ 0.50 MeV

From the measured values of ^{59}Fe and ^{124}Sb the Fermi- and effective Coulomb matrix elements are calculated. From the asymmetry coefficient of ^{103}Ru, and internal conversion measurements of other authors we are able to deduce the spin of the 537 keV level in ^{103}Rh to $5/2^+$ or $1/2^+$. The multipolarity of the 497 keV γ-rays in ^{103}Rh is found to be E2 with a small mixture of M1. (auth)

33128 THE MAGNETIC MOMENT OF THE LOWEST $3/2^-$ STATE IN ^{57}Co. Van Esch, R.; Rots, M.; Coussement, R. (Univ., Leuven, Belgium). Z. Phys.; 233: 477-84(1970).

The reaction $^{54}Fe(\alpha,n)^{57}Ni$ was used to implant ^{57}Co isotopes in ferromagnetic iron. The g-factor of the lowest $3/2^-$ state is determined using the internal field in a constant angle reversed field method. The angular correlation of the 127 to 1,378 keV cascade is also measured. The result of the angular correlation measurement together with reaction data is consistent with $p_{\frac{3}{2}}$ and $p_{\frac{1}{2}}$ single particle assignments to the lowest $3/2^-$ respectively $1/2^-$ state. In view of this statement the quenching of the magnetic moment is discussed. (auth)

33129 NUCLEAR LEVELS OF ^{40}Ca BETWEEN 7 AND 9 MeV. Tellez, Antoine; Ballini, Rene (CEA, Saclay, France). Compt. Rend., Ser. B; 270: 628-30(2 Mar 1970). (In French).

The most probable transitions from the nuclear levels of ^{40}Ca between 7 and 9 MeV, are obtained through the reactions $^{40}Ca(p,p'\gamma)^{40}Ca$ and $^{39}K(^3He,d\gamma)^{40}Ca$. Transitions M 1, $\Delta T = 1$, $\Delta J^\pi = 0$ were observed and a level 2^+, K = 2 having the same configuration as the level 0^+, K = 0 at 5.21 MeV is proposed. The levels of ^{40}Ca can be divided into four characteristic groups (two-phonon states for instance). (auth) (France)

33130 COMPARISON OF EXPERIMENTAL AND THEORETICAL VALUES OF BRANCHING COEFFICIENTS $K\beta^+$ FOR ALLOWED GAMOW-TELLER TRANSITIONS. Biryukov, E. I.; Shimanskaya, N. S. Yadern. Fiz.; 11: 246-51(Feb 1970). (In Russian).

Branching coefficients K/β^+ measured by the authors for six allowed Gamow-Teller transitions in ^{48}V, ^{58}Co, ^{134}La, ^{140}Pr, ^{141}Nd, and ^{143}Sm are compared with the calculated values. Exchange corrections are taken into account in the experimental results, as well as in the theoretical quantities of the ratios K/β^+. The interference Fierz parameter is obtained to be $b = -0.020 \pm 0.009$. Available experimental data on the branching coefficients for allowed Gamow-Teller transitions obtained by other authors are also analyzed. (auth)

33131 GIANT DIPOLE RESONANCE ON Ni ISOTOPES. Goryachev, B. I.; Ishkhanov, B. S.; Kapitonov, I. M.; Piskarev, I. M.; Shevchenko, V. G.; Shevchenko, O. P. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz.; 11: 252-9(Feb 1970). (In Russian).

Photoneutron production cross sections for two isotopes, ^{58}Ni and ^{60}Ni, were obtained in the region of the giant dipole resonance. They have complicated structures and large widths. The integral cross section up to 30 MeV is 310 MeV·mbarn for ^{58}Ni, and 620 MeV·mbarn for ^{60}Ni. Total absorption cross sections for the isotopes are constructed as the sums of the photoneutron and photoproton cross sections. Comparison of the cross sections with the calculated values obtained in various models indicate a number of essential discrepances between the theory and the experiment. (auth)

33132 COULOMB STRIPPING IN WIDE ENERGY RANGE OF EMITTED PROTONS. REACTION $^{62}Ni(d,p)^{63}Ni$ AT E_d = 2.8 MeV. Litvin, V. F.; Nemilov, Yu. A.; Krasnov, L. V.; Gridnev, K. A.; Zherebtsova, K. I.; Lakomkin, Yu. A.; Orlova, T. V.; Rusanova, N. V. (Leningrad State Univ.). Yadern. Fiz.; 11: 273-6(Feb 1970). (In Russian).

The reaction $^{62}Ni(d,p)^{63}Ni$ at E_d = 2.8 MeV was studied. Spectroscopic factors for transitions to the levels of ^{63}Ni with excitation energy up to 5 MeV were obtained. Spectroscopic factors for transitions to the levels with excitation energy up to 3 MeV coincide with the values obtained from experiments at "over-barrier" deuteron energies. For higher excitation energies anomalously large spectroscopic factors were obtained. (auth)

33133 MEASUREMENT OF THERMAL AND RESONANCE CAPTURE IN SODIUM. Yamamuro, N. (Tokyo Inst. of Tech.); Hockenbury, R. W.; Wolfe, R. H.; Block, R. C. Trans. Amer. Nucl. Soc.; 13: 297-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33134 CALCULATION OF CROSS SECTIONS FOR GAMMA-RAY PRODUCTION VIA NEUTRON INELASTIC SCATTERING IN ^{56}Fe. Penny, S. K. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 396-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33135 GAMMA-RAY SPECTRA ARISING FROM FAST-NEUTRON INTERACTIONS IN Fe, Al, Cu, Zn, AND Ti. Maerker, R. E.; Muckenthaler, F. J. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 397(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Nuclear Properties and Reactions, A ≥ 90

Refer also to abstracts 31267, 31641-31643, 31723, 31724, 32921, 33112, 33113, 33119, 33122, 33123, 33125, 33127, 33130, 33163, and 33172.

33136 (AECL-3037(Pt.1)) FISSION PRODUCT DATA FOR THERMAL REACTORS. PART I. CROSS SECTIONS. Walker, W. H. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Dec 1969. 96p. Dep. CFSTI (U. S. Sales Only). AECL $2.00.

A compilation and evaluation of cross section measurements for all fission products with half-lives exceeding ~5 h in the mass range 76 to 165 is presented. Resonance integrals, 2200 m/s cross sections and reactor spectrum cross sections are included. Resonance integrals computed from resonance parameters are included in the resonance data if available. A set of recommended cross sections and resonance integrals is also given for use in the FISSPROD data library. (auth)

33137 ABSOLUTE MEASUREMENT OF ^{99m}Tc. Shibata, Nagao; Suzuki, Kyohei; Tanaka, Kichizo; Takeuchi, Norio (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop., 9th, Tokyo, 1969; 146-8(1969). (In Japanese).

From 9th Conference on Radioisotopes, Tokyo, Japan. See CONF-690548.

A 4π β-γ coincidence system was used to measure the activity of ^{99m}Tc. The γ spectra of separated ^{99m}Tc and an equilibrium mixture of ^{99}Mo and ^{99m}Tc were observed. The internal conversion rate for the 140-keV isomeric transition was determined. (J.W.R.)

33138 GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN ^{110}Cd. Sud, S. P.; Mangal, P. C.; Trehan, P. N. (Panjab Univ., Chandigarh, India). Aust. J. Phys.; 23: 87-97(Feb 1970).

The directional correlations of eight gamma-gamma cascades in ^{110}Cd following the decay of ^{110m}Ag were measured. The cascades investigated are: 764-1505, 1505-658, 1565-658, 706-1565, 1384-884, 884-658, 937-884, and 446-(937)-884 keV, of which the 1565-658, 706-1565 and 446-(937)-884 keV cascades were attempted for the first time. The results of directional correlations of the 1565-658 and 706-1565 keV cascades permit a unique spin assignment of 4 to the 2220-keV level. The multipole character, and mixing ratio of the 446, 706, 884, 937, 1384, 1505, and 1565-keV transitions were determined. (auth) (Australia)

33139 GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN ^{131}Cs. Mangal, P. C.; Sud, S. P.; Bawa, Parveen; Trehan, P. N. (Panjab Univ., Chandigarh, India). Aust. J. Phys.; 23: 79-86 (Feb 1970).

The gamma-gamma directional correlations of the 923-124, 496-124, and 831-216 keV cascades in ^{131}Cs were studied using the slow-fast coincidence method. The results support spin and parity assignments of $5/2^+$, $5/2^+$, $3/2^+$, and $3/2^+$ for the 124, 216, [illegible], and 1046-keV levels respectively, and yield mixing ratios of the 124, 496, 831 and 923-keV γ-rays of (93 ± 1.5)%, E2, and (7 ± 1.5)% M1, (95 ± 2)% M1 and (5 ± 2)% E2, (88 ± 2)% E2 and (12 ± 2)% M1, and (99 ± 1)% M1 and (1 ± 1)% E2 respectively. The spin assignments seem to be in poor agreement with theory. The comparison of the transition rates of M1 and E2 components of the 124-keV γ-ray with that of single particle estimates shows that the M1 component is retarded by a factor of $\sim 7 \times 10^3$ whereas the E2 component is enhanced by a factor of ~56. This indicates some collective effects in the excitation of the 124-keV state. (auth) (Australia)

33140 ON THE DECAY OF ^{148}Pm. Greenberg, W. M. (Univ. of Michigan, Ann Arbor); Fischbeck, H. J. Z. Phys.; 233: 391-7(1970).

The β-γ directional correlation between the 1,930-keV β-group and the 511-keV cascade γ-ray in the 5.4 d ^{148}Pm decay was measured at 14 different γ-energy points. The anisotropy is found to be positive and is (4.4 ± 0.4)% at 1,210 keV. The energies of the γ-rays depopulating the levels in ^{148}Sm were measured using a Ge(Li) spectrometer with an accuracy of better than 1 keV. The γ-ray intensities were determined within 15%. (auth)

33141 THE HALF-LIFE OF THE 344 keV LEVEL IN ^{105}Pd. Schrader, H. (Technische Univ., Brunswich); Stippler, R.; Muennich, F. Z. Phys.; 233: 452-7(1970).

By delayed coincidence techniques, the half-life of the 344-keV level in ^{105}Pd, populated by the decay of ^{105}Ag, was measured: $T_{1/2} = (1.01 \pm 0.05) \cdot 10^{-9}$ s. A comparison of this value with the prediction of the single-particle model shows good agreement for the 344-keV E2 transition. (auth)

33142 THE RESONANCE INTEGRAL OF ^{232}Th IN INFINITE DILUTION. Breitenhuber, L.; Heimel, H.; Pinter, M. (Institut fuer Theoretische Physik und Reaktorphysik, Graz). Atomkernenergie; 15: 83-6(1970).

The resonance integral for infinite dilution of ^{232}Th was measured for both activation ($I_{0.4} = 89.8 \pm 4$ b) and absorption ($I_{0.4} = 93 \pm 6$ b) in the same neutron spectrum assuming $\sigma_0 = 7.4$ b. A control of the results concerning the neutron spectrum of the ARGONAUT reactor was obtained by measuring the resonance integrals of manganese, iodine and aluminum. All calibrations were performed under the very same conditions as the measurements. (auth)

33143 TERNARY FISSION OF URANIUM NUCLEI INDUCED BY HIGH-ENERGY PROTONS. Brandt, R. (Marburg Univ., Ger.); Carbonara, F.; Rinzivillo, R.; Cieslak, E.; Piekarz, J.; Zakrzewski, J.; Jarstorff, I. J. Phys. (Paris); 31: 21-6(Jan 1970).

Ternary fission of uranium was studied with the mica sandwich technique. The existence of this process was firmly established at the proton bombarding energy of 23 GeV. The cross section for ternary fission was found to be (3.5 ± 1.2) mb at 23 GeV and (1.5 ± 1.1) mb at 18 GeV. (auth) (France)

33144 γ-RAY SPECTRUM FROM ^{93}Nb AT INELASTIC SCATTERING OF NEUTRONS. Degtyarev, Yu. G. Yadern. Fiz.; 11: 241-3(Feb 1970). (In Russian).

γ-ray emission from the reaction ^{93}Nb(n,n'γ) was studied by means of a Ge(Li) spectrometer. Monoenergetic neutrons were obtained from an electrostatic accelerator with the reaction T(p,n)^{3}He. In the γ-ray spectrum measured, a previously unknown doublet of 948 and 977 keV lines corresponding to two close states of ^{93}Nb was found. The position of other low-lying levels of Nb is given with improved accuracy. (auth)

33145 DECAY OF ^{108}Sn. Kiselev, B. G.; Burmistrov, V. R. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 11: 244-5(Feb 1970). (In Russian).

The decay of 10-min ^{108}Sn was investigated by means of semiconductor Ge(Li) and the scintillator γ-spectrometers. Energies and intensities of the following transitions were measured: 699.5, 399.8, 271.3, 168.0, 103.5 keV. The total ^{108}Sn decay energy was obtained to be ≤2320 keV, from the ratio of the K-capture probability to the probability of the positronic decay. A decay scheme is proposed for ^{108}Sn that includes the following levels of ^{108}In: 168(3^+), 271(1^+), 670(1^+) keV. (auth)

33146 COEFFICIENTS OF INTERNAL CONVERSION AT HIGH ENERGIES ON K AND L SHELLS OF ^{170}Yb. Trusov, V. F. (Latvian State Univ., Riga). Yadern. Fiz.; 11: 312-13 (Feb 1970). (In Russian).

Coefficients of internal conversion on K and L shells of ^{170}Yb are calculated for the first two multipolarities of electric and magnetic transitions with the following energies: K shell—2—18 mc^2, L_I subshell—2—10 mc^2, L_{II} and L_{III} subshells—2—7 mc^2. The screening was taken into account by means of a statistical potential, internuclear dynamical effect considered on the basis of the black nucleus model. (auth)

33147 ON MEASUREMENT OF NUMBERS OF NEUTRONS FROM FISSION OF NUCLEI BY HEAVY IONS. Karamyan, S. A.; Oganesyan, Yu. Ts.; Sharifov, K. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 11: 304-11(Feb 1970). (In Russian).

Experiments on measurement of mean number of neutrons per fission event are described for fission of excited compound nuclei produced in reactions with heavy ions. Glasses in contact with a layer of the fissible matter (^{237}Np) were used as detectors of the fast neutrons. The obtained data are in agreement with estimates of the number ν_f found in experiments on measurement of mass and charge distributions of the fission fragments. (auth)

33148 MASS AND ENERGY DISTRIBUTION OF FRAGMENTS AT THE FISSION OF ^{237}Np BY NEUTRONS. Kuz'minov, B. D.; Sergachev, A. I.; Smirenkina, L. D. Yadern. Fiz.; 11: 297-303(Feb 1970). (In Russian).

Mass and energy distribution of fragments were studied at the fission of ^{237}Np by neutrons with energy 0.7, 1.1, 1.3, 1.6, 2.1, 2.55, 3.8, 4.6, 5.4 MeV. Results of measurements were analyzed in the frame of statistical model. The fine structure of the yield of fragments is noted to be absent. It is obtained that the intermediate energy of fragments remains constant in the neutron energy range 0.7—2.1 MeV and decreases with the increase of energy of neutrons which induce the fission. (auth)

33149 MASS YIELDS AT THE FISSION OF ^{235}U BY THERMAL AND FAST NEUTRONS FOR FIXED KINETIC ENERGIES. Artem'ev, Yu. M.; Gromov, A. V.; Protopopov, A. N. Yadern. Fiz.; 11: 290-6(Feb 1970). (In Russian).

Mass yields are compared in the fission of ^{235}U by thermal neutrons and by neutrons with the energy 14.8 MeV for fixed total kinetic energies E_K. It is shown that for equal E_K at nuclear excitations corresponding to the fission by thermal neutrons and by neutrons with the energy 14.8 MeV, the positions of maximal yields coincide, i.e., when the excitations of compound nucleus are essentially different, the deformation for the case with the equal energy E_K is at least not so different. The comparison of the mass distributions with the calculations according to statistical model of fission shows that in spite of a good agreement of experimental and calculation curves of the total mass yield, the calculation curves for fixed values of E_K differ considerably from experimental ones. (auth)

33150 ASYMMETRY IN THE ANGULAR DISTRIBUTION OF "DIRECT" PHOTONEUTRONS FROM Bi. Lazareva, L. E.; Lepestkin, A. I. (Saratov State Univ., USSR). Yadern, Fiz.; 11: 266-72(Feb.1970). (In Russian).

Angular distributions of photoneutrons from Bi when emitted by a γ ray bremsstrahlung spectrum with the maximal energy $E_{\gamma\,max} = 28.5$ MeV were measured using the photoemulsion method. The asymmetry observable for different energy groups of photoneutrons is discussed relative to 90° to the beam. (auth)

33151 MEASURED FISSION YIELDS OF ^{99}Mo AND ^{140}Ba IN FAST-NEUTRON-INDUCED FISSION OF ^{239}Pu. Armani, R. J. (Argonne National Lab., Ill.); Gold, R.; Larsen, R. P.; Roberts, J. H. Trans. Amer. Nucl. Soc.; 13: 90-1(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33152 COMPARISON OF SELF-SHIELDED RESONANCE CAPTURE CROSS SECTIONS FOR ^{238}U CALCULATED BY THE GRISM AND THE MC^2 CODES. Fillmore, F. L. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 296-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33153 EPICADMIUM INTEGRAL FISSION CROSS-SECTION MEASUREMENTS FOR TWELVE HEAVY NUCLIDES. Draper, E. Linn Jr. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 13: 298-9(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33154 CAPTURE CROSS SECTION OF ^{240}Pu FROM 4 TO 60 keV. Hockenbury, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y.); Boice, J. D.; Moyer, W. R.; Block, R. C. Trans. Amer. Nucl. Soc.; 13: 299-300(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33155 ETA MEASUREMENTS AT 2 keV ON ^{239}Pu AND ^{235}U. Smith, J. R.; Reeder, S. D. (Idaho Nuclear Corp., Idaho Falls). Trans. Amer. Nucl. Soc.; 13: 300(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33156 RESONANCE CAPTURE INTEGRALS OF ^{166} ^{167} ^{168}Er AND ^{171} ^{172} ^{174}Yb. Liou, H.; Rahn, F.; Ho, C.; Rainwater, J.; Havens, W. W. Jr. (Columbia Univ., New York). Trans. Amer. Nucl. Soc.; 13: 300-1(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33157 STATISTICAL CONSTRUCTION OF RESONANCE STRUCTURE. Ohnishi, T.; Ueda, Y. (Hitachi, Ltd., Tokyo). Trans. Amer. Nucl. Soc.; 13: 303(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33158 ANALYSIS OF THE FRAGMENT CHARACTERISTICS RESULTING FROM THERMAL-NEUTRON FISSION. Deutsch, R. W.; Rodgers, R. C. (Catholic Univ. of America, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 309-10(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33159 INTERMEDIATE STRUCTUE OF THE FISSION WIDTH OF ^{239}Pu. Kikuchi, Yasuyuki (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 312-13(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33160 MEASUREMENT OF NEUTRON RESONANCE PARAMETERS BY MONOENERGETIC NEUTRON ACTIVATION TECHNIQUE AND MONOENERGETIC ABSOLUTE NEUTRON FLUX DETERMINATION IN CRYSTAL SPECTROMETERS. Ertek, Cetin (Univ. of Notre Dame, Ind.); Coskun, S. Zeki. Trans. Amer. Nucl. Soc.; 13: 313-14(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33161 SELF-SHIELDED SCATTERING TRANSFER ARRAY EFFECTS. Mathews, D. R. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 324-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33162 PROMPT GAMMA RAYS FROM THERMAL FISSION OF ^{235}U. Peelle, R. W.; Maienschein, F. C.; Zobel, W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 395-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Nuclear Theory

Refer also to abstracts 32628, 32629, 33000, 33025, and 33028.

33163 ON THE POSSIBILITY OF MEASURING THE COMPOUND-NUCLEUS LIFETIME USING THE BLOCKING EFFECT. Sona, P. (Univ., Florence. Istituto Nazionale di Fisica Nucleare, Florence). Nuovo Cim.; 66A: 663-74(21 Apr 1970).
An analysis of the possibility of measuring the compound-nucleus lifetime using the blocking effect in single crystals was carried out. Detailed calculations of the deformation of the blocking pattern resulting from the finite lifetime of the compound nucleus were performed for the particular case of the reaction ^{107,109}Ag(p,α)^{104,106}Pd. (auth)

33164 ON THE METHODS OF ANGULAR MOMENTUM PROJECTION. Raynal, J. (CEA, Saclay, France). J. Phys. (Paris); 31: 3-20(Jan 1970). (In French).
The projection method with finite rotations, deals with angular functions for normalizations and any operator under study. Their computation for a Slater determinant is derived in the framework of the second quantization formalism. The minimum number of points where these functions must be known is discussed in detail. The method which uses infinitesimal rotation operators, leads directly to a set of linear equations, of which Löwdin gave a solution for a scalar operator. This solution is generalized for a tensor operator. Using generating functions the second method can be shown to be the first one used with a generalized rotation. This way, Löwdin's formula can be demonstrated and Shapiro's formalism understood. In some cases, the use of the two methods provides results which cannot be obtained by any one alone. (auth) (France)

33165 SYMMETRY ENERGY TERM IN THE SEMI-EMPIRICAL MASS FORMULA FOR NUCLEI. Cohen, Bernard L. (Univ. of Pittsburgh). Amer. J. Phys.; 38: 766-7(Jun 1970).
It is shown that the usual treatment of the symmetry energy term in semi-empirical mass formula is incorrect. The correct treatment of the symmetry energy term is illustrated. (J.W.R.)

33166 ONCE-FORBIDDEN β DECAY INTO COLLECTIVE LEVELS OF SPHERICAL NUCLEI AT $72 \leq A \leq 86$. Kopytin, I. V.; Batkin, I. S. (Voronezh State Univ., USSR). Yadern. Fiz.; 11: 342-54(Feb 1970). (In Russian).
Once-forbidden β decays to the ground state as well as to the first collective 2^+ state of spherical nuclei are considered. In framework of the theory of finite Fermi systems the reduced nuclear matrix elements are calculated for nuclei of the interval $72 \leq A \leq 86$. Basing on the exact expressions the shapes of the spectra and the reduced lifetimes ft are calculated. Detail comparison with the experiment is carried out. It is shown that the present scheme of calculations is able to describe properties of the nuclei from the indicated region satisfactorily. (auth)

33167 METHOD TO CALCULATE PROPERTIES OF LOW-LYING STATES OF SPHERICAL NUCLEI. Sapershtein, E. E.; Khodel, V. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 11: 322-33(Feb 1970). (In Russian).
Properties are considered of low-lying states due to interactions of quasiparticles in non-filled shells of spherical nuclei. An equation is obtained expressing the amplitude of pair quasiparticle interaction Γ in terms of the universal amplitude Γ^u of quasiparticle scattering to any angle in the infinite nuclear matter. It is shown that Γ^u contains universal long-range interaction apart from the local parts. The equation for the effective field acting upon the quasiparticles is transformed in such a way that the amplitude Γ^u also enters as a universal interaction. Problems of parametrization of Γ^u are also discussed. (auth)

33168 SIMPLEST SELF-CONSISTENT CALCULATIONS OF NUCLEAR DENSITY. Gorodkov, S. S. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 11: 314-21(Feb 1970). (In Russian).
A model nonlocal two-nucleon potential is presented. The many-particle Schroedinger equation with this potential results in a set of one-particle equations with nonlocal potential of the Perey–Buck type. Numerical calculations performed in this model for a number of nuclei with a unified set of the parameters provide charge distributions and some other nuclear properties that are rather close to the experimental data. (auth)

33169 PROTON POLARIZATION IN COULOMB STRIPPING REACTIONS. Gubkin, I. A. (Leningrad State Univ.). Yadern. Fiz.; 11: 373-81(Feb 1970). (In Russian).
The stripping reaction (d,p) at $l_n = 0$ is considered when Coulomb effects prevail. The method by Ter-Martirosyan is used formulated in terms of the partial waves. It is shown that the proton polarization induced by the Mott-Schwinger interaction is negligibly small contrary to previous results. (auth)

33170 ON THE ROLE OF COMPOUND NUCLEUS LEVELS IN THE NUCLEON SCATTERING PROCESS. Zaretskii, D. F.; Urin, M. G. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 11: 361-72(Feb 1970). (In Russian).

The excitation of compound nucleus levels in the nucleon scattering process is described using the method of attenuation theory. Microscopic interpretation of transmission coefficients is given based on the introduction of a real optical potential and width of one-particle state decay into the levels of compound nucleus. The expression for the diagonal element of the scattering matrix in case of overlapping levels of the compound nucleus is obtained. (auth)

33171 SINGLE-LEVEL INELASTIC SCATTERING IN A SIMPLE APPROXIMATE WAY. Segev, M. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 295(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33172 UNIFIED MODEL OF DEFORMED ODD-ODD NUCLEI FOR NUCLEAR DATA GENERATION AND ANALYSIS. Fu, C. Y. (Univ. of Tennessee, Knoxville); Yost, K. J. Trans. Amer. Nucl. Soc.; 13: 310-11(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33173 ESTIMATION OF NEUTRON AND PHOTON YIELDS FROM ALPHA REACTIONS. Van Tuyl, H. H. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 398-9 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstracts 32366, 32367, 32422–32424, 32426, and 32489.

33174 (BAW–10010(Pt.3)) STABILITY MARGIN FOR XENON OSCILLATIONS: TWO- AND THREE-DIMENSIONAL DIGITAL ANALYSES. (Babcock and Wilcox Co., Lynchburg, Va. Nuclear Power Generation Dept.). Apr 1970. 50p.

Extensive three-dimensional calculations with thermal feedback on the Oconee I core design are presented. Two important factors have been determined: the stability of the core for both the beginning and the end of the fuel cycle; and the adequacy of the axial power shaping rods for controlling axial oscillations. 4 references. (auth)

33175 (WCAP–3017-6092) YANKEE CORE EVALUATION PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1969. Melehan, J. B. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Contract AT(30-1)-3017. 41p. Dep. CFSTI.

Evaluation of burnup and gamma scan measurements conducted on Yankee Core V Zircaloy-4-clad UO_2 fuel rods is presented. Correlation is made of fuel rod axial gamma activity distribution measurements recorded first at the Yankee–Rowe site at the end of Core V life and later at the Westinghouse Post-Irradiation Facility (WPIF) about two years after end-of-life. Evaluation is presented of fuel burnup measurements from ^{148}Nd and heavy element (HE) mass spectrometric analyses. Estimation of fuel rod peak and average burnup and linear power is included. Determination of power sharing between the two test assemblies is presented. Comparison of calculated and measured plutonium production is described. A second area of effort was in the comparison of predicted and measured fission gas release from the Core V fuel. 13 references. (auth)

33176 (WCAP–3017-6093) YANKEE CORE EVALUATION PROGRAM. Quarterly Progress Report for the Period Ending March 31, 1970. Melehan, J. B. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Apr 1970. Contract AT-(30-1)-3017. 16p. Dep. CFSTI.

The mechanical testing program has been extended to study strain rate sensitivity of the Zircaloy-4 tensile properties. A few tests have been completed demonstrating the satisfactory operation of the test equipment. Preparations were made for unit cell nuclear design calculations which will be compared with measured U and Pu isotopic compositions. (auth)

33177 MONTAZH ATOMNYKH REAKTOROV (ENERGETICHESKIKH I ISSLEDOVATEL'SKIKH). (Installation of Nuclear Reactors (Power Plants and Experimental)). Lumer, L. Ya.; Pis'menskii, K. S.; Sdobnov, N. V.; Burnashov, A. N. Moscow; Atomizdat (1970). 192p.

General data and instructions are given on organization and preparations for installation of research and power nuclear reactors. Assembly of the parts, erection of the vessel, fuel basket, and the lid are described in detail. The graphite block stacking and pipeline installation are discussed as well as loading and unloading equipment and shielding construction. Mechanical equipment for the primary cooling circuit, washing out of the primary circuit, technological control, remote control panel, and shielding control are described. Instructions are presented on control instrumentation. (R.V.J.)

33178 WORLD POWER ENGINEERING CONFERENCE, AUGUST 20–27, 1968, MOSCOW. Energ. Atomtech.; 22: 157-272(Apr-May 1969). (In Hungarian). (CONF-680829).

Six papers are included which describe the power plants in Soviet Russia and the world. A brief review is given on the world's fuel and electric power resources. Various types of fuels and their efficiency and economical aspects are evaluated. Conventional, hydroelectric, and nuclear power plants are discussed and compared. New sources and methods for power production and secondary power sources are analyzed. (R.V.J.)

33179 HANDLING EQUIPMENT FOR OPERATING GAS-COOLED PEBBLE-BED REACTOR. Dose, G. (Fried. Krupp GmbH Kranbau, Wilhelmshaven, Ger.). Tech. Mitt. Krupp, Werksber.; 28: No. 1, 25-39(Apr 1969). (In German).

The equipment used for the AVR pebble-bed reactor was developed and built with the aim of achieving a maximum of performance with a minimum of equipment. Reactor loading equipment is described. 9 references. (auth)

33180 DYNAMIC PROGRAMMING FOR EXPANSION PLANNING OF NUCLEAR POWER GENERATION SYSTEMS. Larson, R. E. (Systems Control, Inc., Palo Alto, Calif.); Rees, F. J.; Nichols, J. P. Trans. Amer. Nucl. Soc.; 13: 37-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33181 BEHAVIOR OF FERMI FUEL ASSEMBLIES IN HIGH THERMAL GRADIENTS. Jens, Wayne H. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc.; 13: 115(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33182 INDEPENDENT NUCLEAR ANALYSIS OF THE LACROSSE BWR. Krumbein, A. D.; Luoma, J. D. (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc.; 13: 232-3 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33183 IN-CORE VS EX-CORE DETECTOR RESPONSE AT CONNECTICUT-YANKEE. Forker, J. M. (Westinghouse Electric Corp., Pittsburgh); Johnson, R. Joe.; Andognini, G. Carl. Trans. Amer. Nucl. Soc.; 13: 236(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33184 SELF-POWERED NEUTRON DETECTOR TESTING IN THE BIG ROCK POINT REACTOR. Worsham, H. J. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 13: 236-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33185 INSTALLATION OF FLOW GUARD IN ENRICO FERMI REACTOR SUBASSEMBLIES. Callen, R. C. (Atomic Power Development Associates, Inc., Detroit); Branyan, C. E.; Fron, L. C.; Hill, C.; Michael, H. R.; Pugh, J. T.; Shumaker, P. B. Trans. Amer. Nucl. Soc.; 13: 361(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33186 FLOW REDUCTION RESULTING FROM BLOCKAGE OF FERMI FLOW GUARDS. Ohtake, T. (Central Research Inst. of the Electric Power Industry, Tokyo); Fron, L. C.; Friedland, A. J. Trans. Amer. Nucl. Soc.; 13: 361-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Operation and Economics

Refer also to abstracts 31421 and 33231.

33187 (DOCKET-50171–52) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Monthly Operations Report No. 50, April 1970. (Division of Reactor Licensing (AEC), Washington, D. C.). 23p. Dep. CFSTI.

For Philadelphia Electric Co., Pa.

33188 (TID–25440) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, April 1970. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 11 May 1970. 48p. (In German). Dep. CFSTI.

Operations and maintenance requirements during April 1970 are described. Plant chemistry and health physics measurements are presented. (D.C.C.)

33189 (TID–25441) GARIGLIANO NUCLEAR POWER STATION. Operation Report for the 4th Quarter of 1969. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 31 Dec 1969. 15p. Dep. CFSTI.

Operations and maintenance requirements during October to December 1969 are described. Plant chemistry and health physics measurements are presented. (D.C.C.)

33190 (WASH–1150) TRENDS IN THE COST OF LIGHT WATER REACTOR POWER PLANTS FOR UTILITIES. (United Engineers and Constructors Inst., [Philadelphia, Pa.]. Division of Reactor Development and Technology (AEC), Washington, D. C.). May 1970. Contract AT(30-1)-3770. 42p. GPO $0.50.

The estimated costs of light water reactor plants for electric generation reported in WASH 1082, dated March 1968, are revised, and the costs of large light water reactor plants and coal-fired fossil plants currently being designed are compared. (auth)

33191 EKONOMIKA YADERNOI ENERGETIKI. (Economics of Nuclear Power Plants). Batov, V. V.; Koryakin, Yu. I. Moscow; Atomizdat (1969). 400p.

Economics of nuclear power plants and problems related to fuel cycle management are discussed. The development of nuclear power plants in USSR and in the world is reviewed. Technological and economical aspects of nuclear power plants are described. The fuel cycles, considering the closed and open cycles, the demands of fission materials for various type reactors, and the discrete method for calculating the efficiency of fuel cycles in industry are analyzed. The initial investment, capacity, output of energy, costs, and other economical aspects of large and small nuclear power plants are presented. Industrial planning for transition from conventional power plants to nuclear power plants is reviewed. (R.V.J.)

33192 VERY SMALL NUCLEAR POWER STATIONS FOR DEVELOPMENT OF REMOTE REGIONS IN PERU. Bernstein, Karl. Los Angeles; Univ. of California (1969). 241p.

Thesis.

Very small nuclear power stations, with a capacity of the order of 1000 kW, may enable industrial development of remote but populated regions of Peru and several Andean countries. The cost of energy in small quantities is estimated for several non-nuclear energy sources as well as for nuclear stations. The region in which nuclear power is the economic choice is shown to include a zone of vast development potential in Peru. Criteria are developed to assess the feasibility of integrating various industries into the remote centers, and industries are selected which satisfy the criteria. The number of potential small centers is estimated. Coordinated installation of small centers also could be predicated on the use of diesel power stations, in somewhat less remote regions of Peru and other countries. (Diss. Abstr.)

33193 COMPUTER APPLICATION OF CYCLIC REACTIVITY CARRYOVER EFFECTS IN FUEL MANAGEMENT. Lang, Fred D.; Isakson, Robert A. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 13: 39-40(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33194 EFFECTS OF FAILED FUEL ON THE OPERATIONS OF A COMMERCIAL BWR PLANT. Walke, Gerald J.; Sinderman, Roger W.; Axtell, Charles E. (Consumers Power Co., Jackson, Mich.). Trans. Amer. Nucl. Soc.; 13: 165-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33195 APPLICATION OF OPTIMIZATION METHODS TO NUCLEAR POWER PLANT DESIGN AND OPERATION. Fenech, H. (Univ. of California, Santa Barbara). Trans. Amer. Nucl. Soc.; 13: 182-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33196 BEZNAU-I NUCLEAR STEAM SUPPLY SYSTEM STARTUP AND INITIAL OPERATION EXPERIENCE. Quent, J. P.; Thee, W. B.; Wright, W. E. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 224(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33197 STARTUP AND POWER ESCALATION OF THE R. E. GINNA NUCLEAR POWER STATION. Koprowski, R. R. (Rochester Gas and Electric Corp., N. Y.); White, L. D.; Powell, E. U. Trans. Amer. Nucl. Soc.; 13: 224-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33198 RADIATION LEVEL BUILDUP DURING SECOND CORE OPERATION OF SHIPPINGPORT PLANT. Bergmann, C. A.; Bour, D. P. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 229(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33199 ENRICO FERMI NUCLEAR POWER PLANT DYNAMIC RESPONSE DURING BLASTING. Bleiweis, Paul; Hart, Gary; Smith, Craig B. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 13: 231-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33200 HOW TO MAKE A PROFIT ON WASTE HEAT. Beall, Sam E. Jr.; Samuels, G. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 233-4(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Safety and Siting

33201 (DOCKET-50213-44) CONNECTICUT YANKEE ATOMIC POWER PLANT. License No. DPR-14; Technical Specifications Change No. 12 Approval. (Connecticut Yankee Atomic Power Co., Haddam). 18 Jun 1970. 7p. Dep. CFSTI.

Modifications for Core 2 fuel assemblies are presented. Modifications for the emergency core cooling system and auxiliary power system are also included. (D.C.C.)

33202 (DOCKET-50220-43) NINE MILE POINT NUCLEAR STATION. Authorization to Resume Operations. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 19 Jun 1970. 5p. Dep. CFSTI.

33203 (DOCKET-50231-47) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. License No. DR-15; Technical Specifications Proposed Change No. 2. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). 12 Jun 1970. 19p. Dep. CFSTI.

To improve the leak detecting capabilities in the primary cooling system, the nominal flow rate in the reactor vessel pump-around loop is increased from 1 gpm to 2 gpm. Release limits for radioactive effluents from the plant stack are clarified. Qualifications for supervisory personnel are specified. (D.C.C.)

33204 (DOCKET-50237-50) DRESDEN NUCLEAR POWER STATION, UNIT 2. Spurious Turbine Control System Signal. (Commonwealth Edison Co., Chicago, Ill.). 12 Jun 1970. 1p. Dep. CFSTI.

33205 (DOCKET-50237-51) DRESDEN NUCLEAR POWER STATION, UNIT 2. Proposed Change No. 2 to Appendix A of DPR-19. (Division of Reactor Licensing (AEC), Washington, D. C.). 17 Jun 1970. 10p. Dep. CFSTI.

Modifications for the secondary containment boundaries in the reactor building are presented. (D.C.C.)

33206 (DOCKET-50255-25) PALISADES PLANT. Safety Evaluation, Supplement No. 1. (Division of Reactor Licensing (AEC), Washington, D. C.). 27 May 1970. 27p. Dep. CFSTI.

33207 (DOCKET-50255-26) PALISADES PLANT. AEC Regulatory Staff Safety Evaluation, Supplement No. 2. (Division of Compliance (AEC), Washington, D. C.). 28 May 1970. 18p. Dep. CFSTI.

33208 (DOCKET-50293-26) PILGRIM NUCLEAR POWER STATION. License Application, Amendment No. 14. (Boston Edison Co., Mass.). 10 Jun 1970. 130p. Dep. CFSTI.

Geological data for the reactor site are presented. Circuit diagrams for instrumentation systems are included. Piping systems are illustrated. Engineered safeguards systems are described. Auxiliary power system design parameters are presented. Radiation hazards related to possible accident conditions are described. Inspection and testing programs are listed. Stress requirements for reactor structures are included. (D.C.C.)

33209 (DOCKET-50336-16) MILLSTONE NUCLEAR POWER STATION, UNIT 2. License Application, Amendment No. 10. (Atomic Energy Commission, Washington, D. C. Advisory Committee on Reactor Safeguards). 1 Jun 1970. 3p. Dep. CFSTI.

Estimated total cost and cost sharing figures for the owners of the Millstone Point Power Reactor Unit 2 are presented. (D.C.C.)

33210 (DOCKET-50336-17) MILLSTONE NUCLEAR POWER STATION, UNIT 2. License Application, Amendment No. 11. (Atomic Energy Commission, Washington, D. C. Advisory Committee on Reactor Safeguards). 12 Jun 1970. 17p. Dep. CFSTI.

Additional information is presented on the quality assurance program, radioactive effluents under accident conditions, and turbine overspeed control. (D.C.C.)

33211 (DOCKET-50338-17) NORTH ANNA POWER STATION, UNITS 1 AND 2. License Application, Amendment No. 8. (Virginia Electric and Power Co., Richmond). 16 Jun 1970. 150p. (DOCKET-50339-17). Dep. CFSTI.

Geological, hydrological, and meteorological data are presented for the reactor site. Engineered safeguard systems are described. Inspection techniques for the cooling system are listed. Emergency

core cooling system and auxiliary power system requirements are described. (D.C.C.)

33212 (DOCKET-50344–11) TROJAN NUCLEAR PLANT. Preliminary Safety Analysis Report, Amendment No. 7. (Portland General Electric Co., Oreg.). 12 Jun 1970. 250p. Dep. CFSTI.

Flood and earthquake hazards for the reactor site are analyzed. Design stress requirements for the cooling system and containment structures are described. Design parameters of the emergency core cooling system and auxiliary power system are presented. Component cooling system and ventilation systems are described. Waste disposal system requirements are outlined. Emergency procedures are presented. (D.C.C.)

33213 (DOCKET-50346–10) DAVIS–BESSE NUCLEAR POWER STATION. Preliminary Safety Analysis Report, Amendment 6. (Toledo Edison Co., Ohio). 10 Jun 1970. 152p. Dep. CFSTI.

Revised information on engineered safeguards and the quality assurance program is presented. Additional information is included on seismic events recorded for the site area. Electrical systems and auxiliary power systems are described. Cooling and ventilation systems are discussed. Radioactive effluents are analyzed. (D.C.C.)

33214 (LA–4316) APPLICATION OF RISK ALLOCATION TO REACTOR SITING AND DESIGN. Otway, Harry J. (Los Alamos Scientific Lab., N. Mex.). Jun 1969. Contract W-7405-eng-36. 28p. Dep. CFSTI.

Individual mortality risk is proposed on a basis for assessing reactor safety. The method evaluates reduction of risk by safeguards, and determines radii of exclusion from sites. Accidents are divided into two categories: random independent failures of systems, and "site-induced" accidents, such as earthquakes, that destroy operation of more than one system simultaneously. Fission-product release vs accident probability is determined for both types of accident in a typical 1000-MW(e) pressurized water reactor. Medical data indicate mortality risks of 1×10^{-6} per person per rad from thyroid irradiation, assuming a 1-rad threshold, and 30×10^{-6} per person per rad from whole-body irradiation, with a 100-mrad threshold. Total individual mortality risk per year is determined by applying these dose and risk criteria to the fission-product release curve, and integrating. Societal risk acceptance indicates 10^{-7} as an acceptable yearly death risk to the nearest resident continuously exposed to a nuclear plant. This risk is calculated to occur at the boundary of a 350-meter-radius site of a 1000 MW(e) pressurized water reactor. Calculated risk from reactivity accidents is insignificant compared to that from loss-of-coolant accidents, indicating an imbalance in safeguard design. Earthquake risk is the most significant unknown. The mortality risk concept (neglecting earthquake risk) indicates that 1000-MW(e) thermal reactor siting need be restricted only by the physical size of the facility. 62 references. (auth)

33215 NUCLEAR SAFETY: RESPONDING TO THE CRITICS. Power Eng.; 74: No. 5, 26-34(May 1970).

A discussion is presented concerning the safety standards and guides used in regulating U.S. power reactor radioactive effluents. The effectiveness of present standards and the possible hazards presented by power reactor growth are analyzed. (D.C.C.)

33216 NUCLEAR SAFETY: RESPONDING TO THE CRITICS. 2. Power Eng.; 74: No. 6, 45-9(Jun 1970).

A discussion is presented concerning the safety standards and guides used in regulating U.S. power reactor radioactive effluents. The effectiveness of present standards and the possible hazards presented by power reactor growth are analyzed. (D.C.C.)

33217 NUCLEAR ENERGY: BENEFITS VERSUS RISKS. Jordan, Walter H. Phys. Today; 23: No. 5, 32-8(May 1970).

Some of the controversy over the possible effects of nuclear power plants on the environment and on public health is examined. The risks of nuclear power are compared to hazards inherent in everyday living. The benefits of nuclear power are estimated to far outweigh the risks involved in its use, and the risks of a major nuclear plant disaster are shown to be lower than non-nuclear accident risks acceptable by many facets of U. S. industry. (H.D.R.)

33218 RADIATION CONDITIONS IN THE VK-50 BOILING REACTOR AND IN THE SURROUNDING AREA. Baklanov, S. G.; Knyazev, V. A.; Chechetkin, Yu. V.; Yakshin, E. K. This paper was summarized in At. Energ. (USSR); 27: 49-50(Jul 1969) as paper No. 315/4827. (In Russian).

Radiation conditions in the VK-50 Reactor and in the surrounding area are considered. The characteristics of the γ-radiation near the instrumentation facilities and cooling circuit are presented. Analysis of the surface contamination of the reactor room and equipment is given. Personnel irradiation levels are presented. 7 references. (D.C.C.)

33219 RELATIONSHIP BETWEEN THE SITING OF NUCLEAR REACTORS AND POPULATION. Piper, Henry B. (Oak Ridge National Lab., Tenn.); West, George L. Jr. Trans. Amer. Nucl. Soc.; 13: 215-16(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33220 PROBABILISTIC ASSESSMENT OF AIRCRAFT HAZARD FOR NUCLEAR POWER PLANTS. I. Wall, Ian B.; Augenstein, Richard C. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc.; 13: 217-18(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33221 PROBABILISTIC ASSESSMENT OF AIRCRAFT HAZARD FOR NUCLEAR POWER PLANTS. II. Chelapati, C. V. (Holmes and Narver, Inc., Los Angeles); Wall, Ian B. Trans. Amer. Nucl. Soc.; 13: 218-19(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33222 TRITIUM PRODUCTION AND RELEASE MECHANISMS IN PRESSURIZED WATER REACTOR COOLANT. Mountain, John E.; Leonard, James H. (Univ. of Cincinnati). Trans. Amer. Nucl. Soc.; 13: 220(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33223 PROBLEMS RELATED TO THE DISSEMINATION OF INFORMATION CONCERNING THERMAL POLLUTION AND ENVIRONMENTAL CONTROL. Costagliola, F. (Catholic Univ. of America, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 226(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33224 NUCLEAR POWER AND THE ENVIRONMENT: A COMMUNICATION OR TECHNICAL PROBLEM. Goldman, Morton I. (Nuclear Utility Services, Inc., Rockville, Md.). Trans. Amer. Nucl. Soc.; 13: 226-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33225 ELECTRIC POWER AND THE PUBLIC. Abrahamson, Dean E. (Univ. of Minnesota, Minneapolis). Trans. Amer. Nucl. Soc.; 13: 227(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33226 THERMAL POLLUTION AND THE ENVIRONMENT: AN EMERGING VIEWPOINT. Holton, Robert L. (Atomic Energy Commission, Washington, D. C.). Trans. Amer. Nucl. Soc.; 13: 228(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33227 SEISMIC VIBRATION TESTS AT THE SAN ONOFRE NUCLEAR GENERATING STATION. Smith, Craig B.; Matthiesen, R. B.; Wang, G. S. C.; Ibanez, Paul (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 13: 230-1(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33228 THERMAL EFFECTS STUDIES FOR PALISADES NUCLEAR PLANT. Reynolds, John Z.; Swarts, Kenneth A. (Consumers Power Co., Jackson, Mich.). Trans. Amer. Nucl. Soc.; 13: 233(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Steam and Power Conversion Systems

Refer also to abstract 32419.

Power Reactor Development

Refer also to abstract 31246.

33229 (GA–8725) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(E) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending June 30, 1968. (Gulf Gen-

eral Atomic, Inc., San Diego, Calif.). 29 Jul 1968. Contract AT-(04-3)-633. 171p. Dep. CFSTI.

CONCRETES—properties for use in reactor vessels, measurement of creep and strength
FISSION PRODUCTS—release from coated particle fuels, (E)
FORT ST. VRAIN POWER REACTOR, UNIT 1—pressure vessel for, design and testing of prestressed concrete
—pressure vessel for, testing of thermal barrier for prestressed concrete
—coolant compressors for, testing of
—control rod and shock absorber assembly for, testing of
—fuel management development program for
—physics parameters analysis for
—fuel element design and testing for
—loading machine development for
—steam generators for, development and testing of
—fuels for, preparation and testing of coated particle
GRAPHITE—radiation effects on, fast neutron, (E)
—properties for binder and filler materials for coated particle fuel elements, (E)
NEUTRONS, FAST—effects on properties of graphite, (E)
—effects on coated particle reactor fuels, (E)
REACTOR FUELS—properties of beds of bonded coated particle type, (E)
THORIUM CARBIDES—ThC_2–UC_2, radiation effects on BISO and TRISO coated particles, fast neutron, (E)
URANIUM CARBIDES—ThC_2–UC_2, radiation effects on BISO and TRISO coated particles, fast neutron, (E) (H.D.R.)

33230 (GA–10010) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(e) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending March 31, 1970. (Gulf General Atomic, Inc., San Diego, Calif.). 30 Apr 1970. Contract AT(04-3)-633. 140p. Dep. CFSTI.

FORT ST. VRAIN POWER REACTOR, UNIT 1—thermal insulation for, testing of core support
—fuel management program for
—control elements for, reactivity worth of
—fuel elements for, fast neutron effects on mechanical properties of graphite matrix BISO and TRISO coated thorium carbide (ThC_2)–uranium carbide (UC_2) particle type
—loading machine for, testing of
—boiler for, development of
GRAPHITE—radiation effects on, fast neutron
—properties of binder and filler materials for coated particle fuel elements
NEUTRONS, FAST—effects on mechanical properties of graphite matrix BISO and TRISO coated thorium carbide (ThC_2)–uranium carbide (UC_2) particle type fuel elements
THORIUM CARBIDES—ThC_2–UC_2, radiation effects on BISO and TRISO coated particles, fast neutron
URANIUM CARBIDES—ThC_2–UC_2, radiation effects on BISO and TRISO coated particles, fast neutron (D.C.C.)

33231 (ORNL-TM-2946) OPERATING EXPERIENCE AND DESIGN TRENDS FOR HELIUM-COOLED NUCLEAR POWER REACTORS. Trauger, D. B. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 24p. (CONF-700316–1). Dep. CFSTI.

From Helium Society Symposium, Washington, D. C.

Operating experiences for the Peach Bottom Power Reactor Unit 1, AVR, Dragon, and Los Alamos Turret Reactor are reviewed. Design trends for helium cooled power reactors are presented. 26 references. (D.C.C.)

33232 (TRG-Report-1926) DEVELOPMENTS IN THE A.G.R. AND S.G.H.W.R. SYSTEMS. Bainbridge, G. R. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). Apr 1970. 28p. Dep. CFSTI (U. S. Sales Only).

The pattern for large scale application of nuclear power to electricity generation is outlined and it is shown how developments in the UK have followed this pattern. The general trend of nuclear generating costs is outlined. There is a discussion of the performance of the Magnox stations and of design developments leading to the Mark II (AGR) power stations and to the Mark III (HTR) concept. Parameters of existing high-temperature reactors are compared. The design and operation of the Winfrith SGHWR are discussed and the essential features and advantages of commerical power stations of this type are described. (UK)

33233 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY 1970 ANNUAL MEETING, LOS ANGELES, CALIFORNIA, JUNE 28–July 2, 1970. Farmakes, Ruth (ed.). Trans. Amer. Nucl. Soc.; 13: 1-436(Jun-Jul 1970). (CONF-700608).

For abstracts of individual papers see: 31251–31254, 31287–31297, 31340, 31420–31428, 31466–31471, 31512–31514, 31529, 31575–31577, 31581–31588, 31614–31629, 31638, 31666–31670, 31714–31718, 31726–31734, 31744–31749, 31973, 32013–32015, 32347, 32363–32368, 32415–32434, 32477–32483, 32486–32489, 32496–32499, 32519–32521, 32529, 32530, 32580, 32581, 32615, 32696, 32756, 32829, 32873–32889, 32906, 33079, 33088–33105, 33121–33123, 33133–33135, 33151–33162, 33171–33173, 33180–33186, 33193–33200, 33219–33228, 33234–33239, 33247–33276, 33280–33285, 33293–33307, 33311–33334, 33337–33350, 33353–33358, 33369–33405, 33413–33471, 33479, 33480, 33503–33541, 33546–33552, and 33555–33561.

33234 POSTIRRADIATION EXAMINATION OF EBR-II TANTALUM-CLAD ANTIMONY NEUTRON SOURCES. Strain, R. V.; Eschen, V. G.; Cutforth, D. C. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 13: 99-100(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33235 MATERIALS SELECTION REQUIREMENTS FOR LMFBR IN-CORE STRUCTURALS. Bauer, Arthur A. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc.; 13: 112(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33236 SWELLING AND CREEP EFFECTS UPON FAST REACTOR CORE STRUCTURAL DESIGN. Jackson, R. J.; Sutherland, W. H.; Metcalf, I. L. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 112-13(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33237 FUEL ASSEMBLY DUCT AND CORE CLAMPING CONSIDERATIONS. Anderson, T. L.; Baumeister, E. B.; Bernath, L. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 113(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33238 BEHAVIOR OF IN-CORE STRUCTURAL COMPONENTS: EBR-II. Shewmon, P. G. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 114-15(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33239 LMFBR DESIGN TO ACCOMMODATE STEEL SWELLING. Bump, T. R.; Marr, W. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 129(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Kinetics and Dynamics

Refer also to abstracts 33414, 33486, 33487, and 33544.

33240 (AI-AEC–12946) LMFBR PHYSICS PROGRAMS. Quarterly Technical Progress Report, January–March 1970. (Atomics International, Canoga Park, Calif.). 15 May 1970. Contract AT(04-3)-701. 35p. Dep. CFSTI.

COMPUTER PROGRAMS—VIM-1, debugging of Monte Carlo physics calculations
CRITICAL ASSEMBLIES—control rod cluster in ECEL Core 17, measurement of reactivity worth of tantalum
DATA ACQUISITION SYSTEMS—development of digital computer, for revised fast neutron cross sections
LIQUID METAL FAST BREEDER REACTOR—physics measurement programs during January to March 1970
REACTOR CONTROL ELEMENTS—reactivity worth of cluster arranged rod type tantalum, measurement of (D.C.C.)

33241 (EUR–4464) HEROIC: A NEW METHOD FOR CLUSTER-TYPE FUELLED LATTICE CELL CALCULATIONS. Cuniberti, R.; Daolio, Cl. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 18 Sep 1969. 60p. Dep. CFSTI (U. S. Sales Only).

The HEROIC code is a cell code which solves the integral transport equation in a 39 group structure, using the first collision probability formalism. Collision probabilities are calculated by means of the CLUCOP subroutine developed by Carlvik which deals with a two dimensional cluster geometry. The code is substantially based on the PINOCCHIO scheme but it is not limited to the description of a restricted number of fixed geometries, and clusters can be treated without any homogenization. The machine time on the IBM-360 is typically of the order of 10 minutes. The results

of the code are compared with fine structure measurements performed at Ispra and elsewhere, and it is shown that thermal activation distributions are well reproduced. 19 references. (auth)

33242 (LA-4412) ANALYSIS OF UHTREX TRANSIENT EXPERIMENTS. Vigil, John C. (Los Alamos Scientific Lab., N. Mex.). Nov 1969. Contract W-7405-eng-36. 15p. Dep. CFSTI.

Numerical calculations of transients in UHTREX agree well with experimental measurements. The good agreement confirms the existence and magnitude of the negative fuel element temperature coefficient and provides support for the methods used in the analysis. 11 references. (auth)

33243 NUCLEAR POWER PLANT SIMULATOR BASED ON A COMPLEX COMPUTER SYSTEM. Vinogradov, Yu. V.; Volkov, A. I.; Zhitenev, V. Z.; Zarubin, V. S.; Kolesnikov, A. I.; Malichev, V. V.; Malkin, S. D.; Pogrednoi, G. A.; Sviridov, V. A.; Chistyakova, V. A. This paper was summarized in At. Energ. (USSR); 26: 537(Jun 1969) as paper No. 304. (In Russian).

A simulator is described for a power reactor. The simulator consists of the power reactor control panel and a complex computer system whose components are interconnected by an information exchange system. The computer system consists of an M-220 digital computer, two MN-144 analog computers, and analog-to-digital and a digital-to-analog converter, and a logical block that transmits the control signals. The fundamental characteristics of the computer system and information exchange system and some data on the distribution of the functions of the digital and analog computers are presented. (D.C.C.)

33244 DYNAMIC RESPONSE OF STEAM GENERATION TO FALL-OFF IN POWER OUTPUT IN A TWO-LOOP NUCLEAR POWER FACILITY. Dorri, M. Kh.; Solov'ev, M. M. This paper was summarized in At. Energ. (USSR); 27: 48-9(Jul 1969) as paper No. 314/5023. (In Russian).

The restrictions imposed by a repeated forced circulation steam generating unit on the power output variations of a two-loop power reactor are analyzed. When the power output undergoes rapid changes, there will be overshoots in steam generating capacity in the steam generating unit due to the finite speed of response of the steam separator and lags in the secondary loop piping. These overshoot transients are particularly dangerous when the power output declines rapidly and extensively during the cycle, and the threat of temporary cessation of steam generation becomes real. The physics underlying this phenomenon involves subcooling of the secondary loop water at the inlet to the evaporator when dynamic power fall-off processes are in progress. An analytical formula is derived for the subcooling of the water at the inlet to the evaporator. This formula is a function of the steam generator parameters and a function of the rate at which the power output declines. Suggestions to minimize overshoot conditions are presented. 4 references. (D.C.C.)

33245 SPACE-DEPENDENT DYNAMIC BEHAVIOR OF FAST REACTORS USING THE TIME-DISCONTINUOUS SYNTHESIS METHOD. Kessler, G. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Sci. Eng.; 41: 115-48(Jul 1970).

The time-discontinuous synthesis method is used to describe the space-dependent dynamic behavior of fast reactors, including space-dependent feedbacks. The space dependency of the neutron flux, the material temperatures, and the feedbacks are treated in cylindrical geometry. Two-dimensional trial functions for the multigroup fluxes and the concentrations of the precursors are determined in an iterative procedure. In this way, it is possible to take into account the influence of local reactivity disturbances and feedbacks on the shape functions of the neutron flux and the concentrations of the precursors. (31 references) (auth)

33246 ANALYTIC REPRESENTATION OF FAST-REACTOR NEUTRON-ENERGY SPECTRA. Nissimov, H. (Hebrew Univ., Jerusalem); Reiss, Y.; Yeivin, Y. Nucl. Sci. Eng.; 41: 29-36 (Jul 1970).

An expression for the fast-neutron spectra is suggested. The parameters of the representation can be determined from experimental results, such as activation integrals, or from calculated group fluxes, by the least-squares method. A practical procedure to derive the parameters from results of multigroup calculations is given, and possible applications of smoothing the stepping spectra are discussed. The method was successfully applied to various spherical metallic critical systems. Some examples are given, and the quality of the resulting spectra is discussed. (4 references) (auth)

33247 INTEGRAL MEASUREMENT OF ^{239}Pu ALPHA. Kato, W. Y. (Argonne National Lab., Ill.); Armani, R. J.; Larsen, R. P.; Moreland, P. E.; Mountford, L. A.; Gasidlo, J. M.; Popek, R. J.; Swanson, C. D. Trans. Amer. Nucl. Soc.; 13: 88-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33248 COMPARISON OF MEASURED AND CALCULATED CAPTURE-TO-FISSION RATIOS IN A SOFT SPECTRUM FAST CRITICAL ASSEMBLY. Bretscher, M. M. (Argonne National Lab., Ill.); Gasidlo, J. M.; Redman, W. C. Trans. Amer. Nucl. Soc.; 13: 89-90(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33249 MEASUREMENT OF DOPPLER REACTIVITIES IN A CLEAN FAST CRITICAL ASSEMBLY. Sargis, D. A.; Cohen, S. C.; Moore, R. A.; Sharp, R. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 91-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33250 CELL DEPLETION AND SPECTRUM RECALCULATIONS. Reeve, Harold R.; Gailar, Owen H. (Purdue Univ., Lafayette, Ind.). Trans. Amer. Nucl. Soc.; 13: 172(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33251 CALCULATIONAL SENSITIVITY STUDY FOR A SELECTED LMFBR USING S_n THEORY. Greene, N. M. (Union Carbide Corp., Oak Ridge, Tenn.); Cobb, W. R. Trans. Amer. Nucl. Soc.; 13: 172-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33252 MEASUREMENT OF ∞ OF ThO_2–$^{233}UO_2$ HTGR LATTICE. Lippincott, E. P. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 245(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33253 REACTOR PHYSICS CHARACTERISTICS OF THE HIGH TEMPERATURE REACTOR. Tyror, J. G. (United Kingdom Atomic Energy Authority, Dorchester, Eng.). Trans. Amer. Nucl. Soc.; 13: 247-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33254 EXPERIMENTAL VERIFICATION OF THREE-DIMENSIONAL CALCULATIONS FOR PWR CORES. Hassan, H. H.; Cuneo, J. F.; Wittkopf, W. A. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 13: 248-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33255 STRUCTURAL-SUBASSEMBLY SPECTRA USING SPATIALLY DEPENDENT AND SPATIALLY INDEPENDENT CROSS-SECTION AVERAGINGS. Meneghetti, D.; Phillips, K. E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 256-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33256 EFFECTS OF CROSS-SECTION AVERAGING SPECTRA ON THE WORTH OF REFLECTORS FOR FAST REACTORS. Sehgal, B. R. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 257-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33257 FINE STRUCTURE TRANSIENTS IN FAST REACTOR CELLS. Palmedo, Philip F.; Windsor, Henry H.; Weinstock, Eugene V. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 13: 258(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33258 NEUTRON TRANSPORT EXPERIMENTS WITH BARE METAL SPHERICAL SYSTEMS. Fullwood, R. R. (Los Alamos Scintific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 13: 267(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33259 XENON INSTABILITY PHENOMENON: TIME FOR RETIREMENT. Fullmer, G. C. (Douglas United Nuclear, Inc., Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 279(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33260 USE OF EFFECTIVE DELAYED-NEUTRON FRACTIONS FOR FEW-GROUP SPACE-TIME ANALYSIS OF LIGHT WATER BREEDER REACTORS (LWBR DEVELOPMENT PROGRAM). Yasinsky, J. B.; Foulke, L. R. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.: 13: 280-1(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33261 SPACE- AND SPECTRUM-EFFECTS FOR ROD REMOVAL TRANSIENTS IN AN HTGR. Broglí, R.; Froehlich, R. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.: 13: 282(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33262 ANALYSIS OF THERMAL EXPANSION REACTIVITY COEFFICIENTS FOR AXIALLY SEGMENTED FUEL. Cohen, S. C. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.: 13: 283-4(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33263 USE OF BASIC MEASUREMENTS IN THE PHYSICS DESIGN OF LIQUID METAL FAST BREEDER REACTORS (LMFBRs). Hutchins, B.; Cowan, C. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc.: 13: 287(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33264 CHECK OF NUCLEAR DATA AND METHODS OF CALCULATION BY INTEGRAL EXPERIMENTS. Kiefhaber, Edgar (Kernforschungszentrum, Karlsruhe, Ger.). Trans. Amer. Nucl. Soc.: 13: 288(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33265 INTEGRAL TESTING OF NUCLEAR DATA FOR USE IN LMFBR DESIGN. Pitterle, T. A.; Ramchandran, S.; Paik, N. C. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.: 13: 289(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33266 RESULTS OF SEFOR EXPERIMENTS AT ZERO POWER. Noble, L. (General Electric Corp., Sunnyvale, Calif.); Mitzel, F.; Pflasterer, R.; Wintzer, D.; Becker, R.; Kessler, G.; Lu, Y.; Mansur, L.; Sarma, B. Trans. Amer. Nucl. Soc.; 13: 289-90 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33267 APPLICATION OF CRITICAL EXPERIMENT DATA TO THE DESIGN OF THE AI-GPU FBR. Specht, Eugene R.; Fillmore, Frank L. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 291-2(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33268 DATA ACQUISITION AND ANALYSIS FOR FAST REACTOR PHYSICS IN JAERI. Hirota, J.; Katsuragi, S.; Hirata, M. (Japan Atomic Energy Research Inst., Ibaraki). Trans. Amer. Nucl. Soc.: 13: 293(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33269 DEMONSTRATION REACTOR BENCHMARK CRITICAL ASSEMBLIES PROGRAM. Till, C. E.; Davey, W. G. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.: 13: 293-4(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33270 RESOLVED RESONANCE REACTION RATES IN FAST REACTORS. Stacey, W. M. Jr. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.: 13: 295-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33271 ANALYSIS OF CAPTURE IN FAST REACTOR SYSTEMS. Goldstein, Rubin (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.: 13: 297(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33272 EVALUATION OF NUCLEAR EFFECTIVE TEMPERATURE IN THERMAL POWER REACTOR FUEL. Olhoeft, J. E. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.: 13: 306-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33273 DETAILED ANALYSIS OF SPACE-DEPENDENT PHENOMENA. Miller, L. B.; Jarka, R. E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.: 13: 307-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33274 HETEROGENEITY EFFECTS ON LARGE FAST BREEDER FUEL-CYCLE CALCULATIONS. Hirons, Thomas J.; Alcouffe, Raymond E. (Los Alamos Scintific Lab., N. Mex.). Trans. Amer. Nucl. Soc.: 13: 317(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33275 PLUTONIUM BUILDUP IN POWER REACTOR CORES. Epel, Lester G.; Shotkin, Louis M. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.: 13: 318(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33276 DYNAMIC SIMULATION AND ANALYSIS OF EBR-II ROD-DROP EXPERIMENTS. Campise, A. V. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.: 13: 353-4 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Control Systems

33277 (DUN-SA-133) THE XENON INSTABILITY PHENOMENON: TIME FOR RETIREMENT. Fullmer, G. C. (Douglas United Nuclear, Inc., Richland, Wash.). 28 May 1970. Contract AT(45-1)-1857. 5p. (CONF-700608-3). Dep. CFSTI.
From American Nuclear Society Meeting, Los Angeles, Calif.

The three main points discussed are: (1) xenon oscillation is not nuclear safety problem; (2) properly designed kinetics protection for control withdrawal accidents will easily protect against the much less severe xenon phenomenon; and (3) even the maximum peaking potential from xenon oscillation may be easily and conservatively estimated from first principles. A brief review is also made of the local trend control concept for precluding xenon oscillations by operating procedure. (auth)

33278 CONTROL SYSTEM FOR FAST REACTORS. Terasawa, Shoichi; Inoue, Kotaro (to Hitachi, Ltd.). U. S. Patent 3,510,399. 5 May 1970. Priority date 9 Mar 1965, Japan.

A control system for a fast nuclear reactor is described. The control tubes are arranged so as to be distributed exterior of the central portion of the core. Means are provided for feeding a control material of liquid form to the control tubes. The level of liquid control material in the control tubes is controlled in a manner to assure that under all conditions of operation a space within the control tubes is left void of liquid control material at least within the exteriorly distributed control tubes. As a result spaces within the control tubes located exterior of the central portion of the reactor core are maintained void of liquid control material so as to provide radially extending paths from the central portion of the core which are void of liquid control material. (AEC)

33279 INFLUENCE OF ASYMMETRY OF THE NEUTRON BALANCE OPERATOR ON THE STABILITY OF STEADY OPERATING CONDITIONS OF A POWER REACTOR. Postnikov, I. S.; Sabaev, E. F. This paper was summarized in At. Energ. (USSR); 26: 56-7(Jan 1969) as paper No. 256. (In Russian).

Analysis of control systems for the spatial distribution of neutrons in which the number of independent controls is less than the number of unstable harmonics is presented. One-group diffusion approximation equations are used as a mathematical model and small deviations of the dependent variables from their values during steady operating conditions are considered. 9 references. (D.C.C.)

33280 CHARACTERIZATION OF BORON CARBIDE FOR FAST REACTOR ABSORBERS. Copeland, G. L.; Mateer, R. S.; Martin, W. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 100-1(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33281 SPEED TESTS ON SOME CONTROL COMPUTERS. Cohn, Charles Erwin (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 177-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33282 DESIGN BASIS FOR THE PROTECTION SYSTEM AND THE ACTUATOR SYSTEMS OF NUCLEAR-FUELED GENERATING STATIONS. Ferguson, R. L. (Atomic Energy Commission, Washington, D. C.); Holland, L. K.; Ebersole, J. C. Trans. Amer. Nucl. Soc.; 13: 221-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33283 DIGITAL CONTROL OF NUCLEAR POWER REACTORS. Powers, David V.; Ward, Thomas J. (Clarkson Coll., Potsdam, N. Y.). Trans. Amer. Nucl. Soc.; 13: 239-40(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33284 NEUTRON DETECTION SYSTEM FOR OPERATION IN VERY HIGH GAMMA FIELDS. Roux, D. P. (Oak Ridge National Lab., Tenn.); Ricker, C. W.; DeLorenzo, J. T. Trans. Amer. Nucl. Soc.; 13: 242-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33285 NEUTRONIC AND THERMAL-HYDRAULIC CHARACTERISTICS OF A HIGH-WORTH CONTROL ROD FOR EBR-II. Sehgal, B. R.; Lo, R. K. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 343(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Cooling Systems

33286 (IN-1371) ELK RIVER ACOUSTIC LEAK DETECTION TESTS. Parry, D. L.; Robinson, D. L. (Idaho Nuclear Corp., Idaho Falls). May 1970. Contract AT(10-1)-1230. 32p. Dep. CFSTI.

Laboratory tests and subsequent field tests conducted to show the feasibility of using acoustic techniques for detecting and locating leaks in the primary coolant system of water-cooled nuclear power reactors is discussed. The laboratory tests showed that acoustic bursts can be created in a crack when water is forced through the crack under temperature and pressure conditions necessary to cause the water to flash to steam within the length of the crack. Tests conducted on the Elk River reactor verified laboratory findings. Elk River tests also show the definite potential for using acoustics to detect and locate leaks in reactor pressure systems. (auth)

33287 STUDY OF HOT SPOT FACTOR FOR CYLINDRICAL CORES. Miyamoto, Yoshiaki (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi; 12: 254-8(1970). (In Japanese).

In the reactor core, there are produced a number of hot channels or hot spots. A discussion is given on the probability that no hot channel or hot spot exceeds a maximum value. By means of the probability multiplication formula, it is clarified that the number of hot spots is related to the nonfailure probability. A method for analyzing the hot spot factor is proposed for cylindrical cores. The method is presented in the form of diagrams, so as to be readily applicable to the thermal design of reactor cores. Given a requirement for the nonfailure probability to be 99.87% with a cylindrical core, the number of hot spots is related to a confidence level coefficient at the core center and this relation is shown in diagrams. 5 references. (auth)

33288 EFFECT OF GAS ENTRAINMENT ON THERMAL-HYDRAULIC PERFORMANCE OF SODIUM COOLED REACTOR CORE. Hori, Masao; Friedland, A. J. (Atomic Power Development Associates, Inc., Detroit). J. Nucl. Sci. Technol. (Tokyo); 7: 256-63(May 1970).

With the view to determining whether or not gas entrained in the sodium coolant could cause overheating of a fast reactor core, the following items were studied: (1) The effect of gas entrainment on the coolant flow rate and on coolant temperature rise. (2) The effect of gas entrainment on the coolant heat transfer coefficient and film temperature drop. Equations were derived to serve in estimating the thermal-hydraulic effect of the gas entrainment, and calculations performed therewith to obtain information on conditions corresponding to the Core A under operation in the Fermi Reactor. The results of the examination reveal that in the Fermi Reactor an amount of gas almost inconceivable as a practical possibility must be entrained before the coolant or the fuel surface would be heated to the boiling point of sodium. 8 references. (auth)

33289 FLOW CONTROL ARRANGEMENT IN A NUCLEAR REACTOR. Winkler, Eberhard; Doerler, Rudolf (to Licentia-Patent-Verwaltungs-GmbH). U. S. Patent 3,510,396. 5 May 1970. Priority date 17 Feb 1965, Germany.

The flow rate of a primary coolant through the fuel elements of a nuclear reactor is automatically controlled by a simple thermostatic control tube to minimize variations of temperature within the nuclear reactor. The thermostatic control tube acts as a conduit for the primary coolant and, by virtue of its temperature expansions and contractions, it also varies the coolant outlet area and thereby varies the flow rate of the coolant as a function of the coolant temperature. (AEC)

33290 INVESTIGATION OF HYDRAULIC CIRCUITS IN FAST REACTOR POWER PLANTS. Rineiskii, A. A.; Pyshin, V. K. This paper was summarized in At. Energ. (USSR); 27: 216(Sep 1969) as paper No. 334/5112. (In Russian).

A mathematical model for studying hydrodynamic processes in fast power reactor systems is proposed. A system of nonlinear differential equations describing the hydraulic processes in the reactor and in operating shutdown pumps is formulated. 3 references. (D.C.C.)

33291 EXPERIMENTAL INVESTIGATION ON THE INFLUENCE OF RADIAL POWER DISTRIBUTION ON CRITICAL HEAT FLUX IN A 19 ROD CLUSTER. Gaspari, G. P.; Hassid, A.; Vanoli, G. (CISE, Milan). Energ. Nucl. (Milan); 17: 359-70 (Jun 1970).

The results of an experimental investigation performed with a 19 rod cluster, to evidence the effect of radial power distribution on critical heat flux with this geometry, are presented. These experiments were carried out with the CISE IETI-3 heat transfer test facility, at a 50 kg/cm^2 abs. pressure, the heated length of the test section being 3 m. The main results are discussed and compared with the existing correlations, and the validity limits of such correlations in predicting the radial power distribution effect are evidenced. 10 references. (auth)

33292 THEORETICAL INVESTIGATIONS ON SODIUM BOILING IN FAST REACTORS. Schlechtendahl, E. G. (Gesellschaft fuer Kernforschung mbH, Karsruhe, Ger.). Nucl. Sci. Eng.; 41: 99-114(Jul 1970).

Sodium boiling situations in a fast-reactor fuel element can be calculated with the BLOW-2 code from their initiation until fuel-pin failure occurs. The model which is used is substantiated by means of a theoretical analysis of the cause of the typical piston-type bubble generation, and it is checked against water and sodium tests. Typical examples of sodium boiling incidents are given. The probability of occurrence of severe nuclear excursions generated by sodium boiling is calculated. (41 references) (auth)

33293 SURVEY OF DESIGN CONSIDERATIONS FOR LMFBR STEAM GENERATORS AND INTERMEDIATE HEAT EXCHANGERS. Davis, S. A.; Kuczen, K. D. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 110-11(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33294 FBR MODULAR STEAM GENERATOR FABRICATION AND INSPECTION. McDonald, J. S. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 111(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33295 REVIEW OF MASS TRANSFER EFFECTS ON MATERIALS IN LMFBR PRIMARY SODIUM SYSTEM. Spalaris, C. N.; Young, R. S.; Zebroski, E. L. (General Electric Co., Sunnyvale, Calif.). Trans. Amer. Nucl. Soc.; 13: 113-14(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33296 DESIGN CRITERIA FOR SODIUM-COOLED FAST REACTOR COMPONENTS. Slember, Richard (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc.; 13: 116-17 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33297 CODE CONSIDERATIONS CONCERNING LMFBR. Cooper, W. E.; Landers, D. F. (Teledyne Materials Research, Waltham, Mass.). Trans. Amer. Nucl. Soc.; 13: 117(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33298 TRANSITION TEMPERATURE CONSIDERATIONS FOR THICK-WALL NUCLEAR PRESSURE VESSELS. Canonico, D. A. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 168-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33299 BORON CONCENTRATION METER. Gopal, Raj (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 237-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33300 MEASUREMENT OF THROAT PRESSURE IN FLASHING SODIUM CRITICAL FLOW. Fauske, Hans K.; Henry, Robert E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 330-1(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33301 INCIPIENT LIQUID SUPERHEAT, HYSTERESIS EFFECT, AND EQUILIBRATION IN FORCED-CONVECTION FLASHING SODIUM FLOW. Fauske, Hans K.; Grolmes, Michael A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 331-2(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33302 EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF FUEL ELEMENT VIBRATION IN TWO-PHASE PARALLEL FLOW. Gorman, D. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Amer. Nucl. Soc.; 13: 333(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33303 FUEL ROD AND BUNDLE VIBRATIONS INDUCED BY COOLANT. Cali, G. P.; Grillo, P.; Testa, G. (CNEN, Casaccia, Italy). Trans. Amer. Nucl. Soc.; 13: 333-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33304 EXPERIMENTAL VIBRATION CHARACTERISTICS OF A BWR FUEL ASSEMBLY. Ferrucci, N.; Pitimada, D. (CNEN, Casaccia, Italy). Trans. Amer. Nucl. Soc.; 13: 336-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33305 HIGHER-MODE DENSITY-WAVE OSCILLATIONS. Yadigaroglu, George (Massachusetts Inst. of Tech., Cambridge); Bergles, Arthur E. Trans. Amer. Nucl. Soc.; 13: 337(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33306 TRANSIENT AND STEADY-STATE NATURAL CONVECTION OF MERCURY IN A CLOSED VERTICAL RECTANGULAR CHANNEL. Heinisch, R. P. (Argonne National Lab., Ill.); Viskanta, R.; Singer, R. M. Trans. Amer. Nucl. Soc.; 13: 344-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33307 EVALUATION OF THERMOCOUPLES FOR BLOCKAGE DETECTION IN LMFBR FUEL ASSEMBLIES. Keaten, R. W. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 362-3(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Fuels

33308 (ANL-7605) SYMPTOMS AND DETECTION OF A FISSION-PRODUCT RELEASE FROM AN EBR-II FUEL ELEMENT. CASE 1. DEFECT ABOVE FUEL ELEVATION. Fryer, R. M.; Ebersole, E. R.; Henault, P. B.; Smith, R. R. (Argonne National Lab., Ill.). Jan 1970. Contract W-31-109-eng-38. 36p. Dep. CFSTI.
Shortly after a routine reactor startup in September 1968, the equilibrium activity of ^{135}Xe in the primary cover gas increased to a level twice that noted during previous power runs. The increase was gradual, continuous, and consistent with the half-lives of the respective iodine-xenon fission-product pair. Analyses of primary coolant samples revealed a corresponding increase in the activity level of ^{131}I. No increase was registered by either the FERD or the FGM. Since the FERD and FGM are sensitive to delayed-neutron emitters and to their daughters, respectively, discrimination against shorter-lived halogen fission products was evident. From this evidence and from the shape of the ^{135}Xe buildup curve, it was concluded that bond sodium containing relatively long-lived halogen fission products was being extruded through a cladding perforation. The results of exposed-fuel calibration studies subsequently confirmed the release, and mathematical models of the release rate were developed. To identify the origin of the release, groups of subassemblies were removed, and the reactor was restarted. The search ultimately was narrowed to control rod No. 2 (L-462) after a positive correlation of the ^{135}Xe activity and the position of rod No. 2 had been definitely established. Postirradiation examination located a tear in the fuel-element jacket above fuel elevation and confirmed that coolant sodium had penetrated the tear. 17 references. (auth)

33309 (ANL/EBR-15) LOADING DIAGRAMS OF EXPERIMENTAL SUBASSEMBLIES IRRADIATED IN EBR-II RUNS 5 THROUGH 42. Case, J. C. (comp.) (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). May 1970. Contract W-31-109-eng-38. 99p. Dep. CFSTI.
The loading diagrams are presented for all experimental subassemblies as they were fabricated for irradiation in EBR-2 runs 5 through 42. Each diagram gives the location, identification number, and content of each element in the subassembly. Information with each diagram gives the type of hardware, orifice size, results of flow testing of the fabricated assembly, date and place of assembly, and date placed into the reactor. (D.C.C.)

33310 FORMULATION OF A MODEL FOR FUEL CYCLES IN A PEBBLE BED REACTOR. Barrett, P. R. (Univ. of New South Wales, Kensington, Australia). Nucl. Eng. Design; 12: 18-32(May 1970).
A model is developed in which the fuel spheres to be selected for injection into the reactor core are stored in groups, according to their neutron irradiation. Spheres are selected from each given group by a random process; but, the rate of selection of spheres for injection into the core from every group is non-random in nature. It is shown that, if there is more than one single group (representing a range of neutron irradiation) in the fuel store, it is possible to optimize the system according to some desirable criterion. As an example the optimization criterion of minimizing the square of the deviations of the neutron flux about its mean critical level is chosen; the fluctuations in neutron flux arise mainly owing to the partially random nature of the neutron irradiation of the fuel spheres entering the core from the store. 4 references. (auth)

33311 PLUTONIUM RECYCLE FUEL EVALUATIONS AT PNL. Freshley, M. D.; Carter, D. G.; Burley, T. B. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 31 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33312 PERFORMANCE OF THREE SEALED $(U,Pu)O_2$ GCFR FUEL PINS. Fitts, R. B. (Oak Ridge National Lab., Tenn.); Long, E. L. Jr.; Cuneo, D. R.; Lindgren, J. R. Trans. Amer. Nucl. Soc.; 13: 34-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33313 IRRADIATION-INDUCED STRUCTURAL CHANGES OBTAINED IN ThO_2–UO_2 FUEL (LWBR DEVELOPMENT PROGRAM). McCauley, J. E. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 35-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33314 FACTORS AFFECTING THE OPTIMUM FUEL CYCLE. Deonigi, D. E. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 37(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33315 EFFECT OF TIGHT MONEY ON PRE-REACTOR FUEL CYCLE COSTS. Tulenko, J. S. (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc.; 13: 42-3(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33316 DESIGN CONSIDERATIONS FOR PLUTONIUM RECYCLE IN BWR'S AND PWR'S. Sofer, G. A. (Nuclear Technology Corp., White Plains, N. Y.). Trans. Amer. Nucl. Soc.; 13: 44-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33317 FUEL MANAGEMENT OF MIXED-OXIDE FUEL ASSEMBLIES IN PWR'S. Tulenko, J. S.; Tomonto, J. R.; Fiscella, J. M. (United Nuclear Corp., Elmsford, N. Y.). Trans. Amer. Nucl. Soc.; 13: 45-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33318 PERFORMANCE OF SMALL ASSEMBLIES OF FAST REACTOR FUEL ELEMENTS IN A THERMAL CORE. Carter,

J. C. (Argonne National Lab., Ill.); Barts, E. W.; Davis, M. V.; Morris, R. A. Trans. Amer. Nucl. Soc.; 13: 94(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33319 APPLICATION OF X-RAY TEXTURE STUDIES TO EXPLAIN THE ANOMALOUS PERFORMANCE OF CENTRIFUGALLY BONDED EBR-II DRIVER FUEL. Walter, C. M. (Argonne National Lab., Idaho Falls, Idaho); Mueller, M. H.; Bacca, J. P. Trans. Amer. Nucl. Soc.; 13: 95-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33320 EXAMINATION OF UN-FUELED PINS IRRADIATED AT 1400°C CLADDING TEMPERATURE. Washburn, T. N.; Thoms, K. R.; Weaver, S. C.; Cuneo, D. R.; Long, E. L. Jr. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 101-2(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33321 FUEL DEVELOPMENT FOR FRENCH FAST BREEDER REACTOR. Moranville, C. (CEN, Cadarache, France). Trans. Amer. Nucl. Soc.; 13: 104(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33322 ISUNE 1: A COMPUTER CODE FOR PERFORMING RADIATION, THERMAL, AND MECHANICAL ANALYSIS OF OXIDE FUEL PINS OF FAST REACTORS. Ma, Benjamin M.; Cheng, C. K. (Iowa State Univ., Ames). Trans. Amer. Nucl. Soc.; 13: 125(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33323 COMPARISON BETWEEN BEMOD MODELING CODE PREDICTIONS AND OBSERVED PERFORMANCE OF EBR-II DRIVER FUEL. Walter, C. M. (Argonne National Lab., Idaho Falls, Idaho); Bacca, J. P.; Beck, W. N. Trans. Amer. Nucl. Soc.; 13: 125-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33324 APPLICATION OF THE BEMOD FUEL-ELEMENT MODELING CODE TO EBR-II BLANKET ELEMENTS. Koenig, J. F.; Eschen, V. G.; Walter, C. M. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 13: 126-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33325 PROBABILISTIC DESIGN OF FUEL ROD CLADDING. Garkisch, Hans-Dieter; Patterson, John F. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 13: 127-8 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33326 IMPROVED LMFBR FUEL ELEMENT. Bump, T. R.; Lennox, D. H.; Greenspan, H. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 128(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33327 IRRADIATION PERFORMANCE OF FUEL RODS CONTAINING COATED PARTICLES. Luby, C. S.; Hooker, J. R.; Harmon, D. P. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 135(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33328 HTGR COATED-PARTICLE FUEL PERFORMANCE UNDER HIGH IRRADIATION EXPOSURES. Luby, C. S.; Harmon, D. P. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 135-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33329 COMPARISON OF RUPTURE DATA FROM IRRADIATED FUEL RODS AND UNIRRADIATED CLADDING. Hobson, D. O.; Osborne, M. F.; Parker, G. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 150(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33330 RESONANCE OVERLAP OF ^{233}U AND ^{233}Pa. Heffley, R. A.; Luce, R. G.; Mewherter, J. L.; Stricos, D. P. (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Amer. Nucl. Soc.; 13: 244-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33331 HEAT TRANSFER IN HETEROGENEOUS UO_2–PuO_2, AND UC–PuC FUELS IN EBR-II. Lo, R. K.; McNeal, N. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 342-3(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33332 CYGRO-3: AN IMPROVED MODEL FOR PREDICTION OF OXIDE FUEL ROD PERFORMANCE (LWBR DEVELOPMENT PROGRAM). Duncombe, E. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.: 13: 349-50(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33333 ANALYSIS OF THE TRANSIENT CAPABILITY OF ROD-TYPE FUEL ELEMENTS (LWBR DEVELOPMENT PROGRAM). Campbell, W. R.; Goldberg, I. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 350-1(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33334 IN-PILE DIMENSIONAL CHANGES OF ZIRCALOY-4 TUBING AT LOW STRESSES (LWBR DEVELOPMENT PROGRAM). Daniel, R. C. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 351-2(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Auxiliary and Emergency Systems

33335 (ORNL–4524) REMOVAL OF RADIOACTIVE AEROSOLS ON HIGH EFFICIENCY FIBROUS FILTER MEDIA. Davis, R. J.; Truitt, J.; Gill, J. S.; Adams, R. E. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 55p. Dep. CFSTI.

One objective was to observe filtration efficiencies of commercially available, high efficiency fibrous filter media to smokes of those materials possible and under environmental conditions expected in water-cooled reactor containments during a severe accident. A second objective was to provide additional understanding of the performance of high efficiency fibrous filters. The basic experiments were filtration efficiency tests in which aerosol was generated in an electric arc between an activated stainless steel (or zirconium) tube filled with an insert of UO_2 and tungsten. The aerosol was pumped through a filter pack which contained three filters in series. The filtration efficiency was taken to be the ratio of the activity on the first filter to the total on all three filters. Filter efficiency was measured for eight different commercial media vs velocity (3.5-10 ft/min), humidity zero to 100% relative humidity) and temperature (25, 60 and 100°C). Other filtration efficiency tests were done to compare the measurement with the standard DOP test, to determine possible differences in filter efficiency with SS–UO_2 vs ZrO_2–UO_2 particles, and to determine possible effects of water condensing on the filter fibers. Subsidiary experiments were done to estimate the distributions of fiber diameters (microscopically) for four available media. Other subsidiary experiments were done to estimate the particle size distribution in the arc-generated aerosol with electronic sizing and counting instruments and with a low pressure impactor. The basic experiment was shown to measure filter efficiencies in the range near 99.97% to ±0.01–0.02. The method was shown to give efficiency values in good agreement with those measured with 0.3 micron DOP particles. Penetrations were the same for SS–UO_2 aerosol as for ZrO_2–UO_2 aerosol. The eight different commercial media provided similar efficiencies under all conditions in which comparisons were made. The effects of increasing velocity (from 3.5 to 10 ft/min), of increasing the temperature (from 25 to 100°C), of increasing humidity (from zero to 100% relative humidity) or of steeping the media in saturated, 80°C steam and air prior to use, were to increase the penetration by factors of 1.5 to 2. The subsidiary experiments to characterize the filter media indicated that most of the fibers were of diameters near 2 microns or near 0.15 micron. The large fibers apparently hold the mat together; the tiny fibers are largely responsible for the filtering action. 18 references. (auth)

33336 APPLICATION OF RELIABILITY THEORY TO A REACTOR SAFETY CIRCUIT. Babik, S. (English Electric Co. Ltd., Whetstone, Eng.). J. Roy. Statist. Soc., Ser. C; 17: 137-56(1968).

The reactor safety circuit considered is that of a "single r from

m" design. Such a circuit comprises m guard lines in parallel, continuously monitoring the reactor performance. When r or more lines signal the presence of a dangerous reactor condition the reactor is automatically shut down. Two types of circuit failures are examined, a safe failure which results in a spurious reactor shutdown, and an unsafe failure when no tripping signal can be produced even if the reactor is in a dangerous condition. The repair of a guard line which failed safe starts at once, after the occurrence of a fault, provided that an engineer is available. No circuit failure will occur if the fault is eliminated before r−1 other faults have occurred. The effects of using a single short circuiting facility in the servicing of circuit faults were also investigated. Formulae for the calculation of the frequency of safe and unsafe circuit failures are derived, treating time as a continuous variable. The results obtained differ from those based on time represented by a series of discrete intervals. Some illustrative examples are given. (auth)

33337 REACTOR CONTAINMENT SPRAY SYSTEM RESEARCH PROGRAM. Row, T. H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 202(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33338 DESIGN OF SPRAY ADDITIVE SYSTEMS. Gallagher, J. L.; Green, L. D.; Marchese, R. T. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 202(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33339 DROP SIZE DISTRIBUTION AND SPRAY EFFECTIVENESS. Pasedag, W. F.; Gallagher, J. L. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 203(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33340 IODINE REMOVAL IN THE ICE CONDENSER SYSTEM. Malinowski, D. D.; Picone, L. F. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 204-5 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33341 RADIATION AND THERMAL STABILITY OF SPRAY SOLUTIONS. Zittel, H. E.; Row, T. H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 205(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33342 SODIUM THIOSULFATE SPRAY SYSTEM FOR RADIOIODINE REMOVAL. Joyce, W. E. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 13: 205(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33343 STABILITY OF SODIUM THIOSULFATE SPRAY SOLUTION. Bishop, W. N.; Nitti, D. A. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 13: 206(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33344 STUDIES ON IODINE TRAPPING BY WATER SYSTEMS AT STUDSVIK. Devell, L.; Hesbol, R.; Bachofner, E. (Aktiebolaget Atomenergi, Stockholm). Trans. Amer. Nucl. Soc.; 13: 207-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33345 REMOVAL OF IODINE FROM ATMOSPHERE BY SPRAYS. Nishizawa, Y.; Oshima, S.; Maekawa, T. (Mitsubishi Atomic Power Ind., Inc., Omiya, Japan). Trans. Amer. Nucl. Soc.; 13: 209-10(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33346 SCALBATRAIO CENTER FOR RESEARCH IN NUCLEAR SAFETY. Guerrini, B. (Univ., Pisa, Italy). Trans. Amer. Nucl. Soc.; 13: 212(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33347 PROTECTIVE COATINGS (PAINTS) FOR PWR AND BWR REACTOR CONTAINMENT FACILITIES. Watson, C. D.; Griess, J. C.; Row, T. H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 212-13(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33348 INSTRUMENTED SUBASSEMBLY SYSTEM IN EBR-II. Smaardyk, A.; Divona, C.; Hutter, E. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 355-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33349 GLASS MODEL TESTS ON EMERGENCY CORE COOLING SYSTEMS. Murphy, J. H.; Redfield, J. A.; Williams, J. S. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 385-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33350 USE OF FLASH-2 TO EVALUATE ECC PERFORMANCE. Jensen, W. L.; Bingham, B. E. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 13: 387-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Operation and Economics

33351 (SRARI-P-11) SOME ECONOMIC ASPECTS OF THE FAST REACTOR FUEL CYCLE. Kazachkovskii, O. D.; Kirillov, E. V. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1968. 15p. (In Russian). Dep. CFSTI (U. S. Sales Only).
The economic breeding ratio is suggested to use in economical and engineering calculations of Atomic Electrical Stations. Its application eliminates the ambiguity of results, simplifies the economical analysis of AES as well as the comparison of fast and thermal reactors. Such an index as reactivity regeneration factor is introduced to allow the amount of the excessive fuel from fast converters to be correctly determined. Some problems concerning the cost of Pu, in particular the dependence of fuel components upon the Pu cost for systems with different doubling times are also considered. (auth)

33352 IONIZING RADIATION AS A SOURCE OF ENERGY FOR MAN. Damy de Souza Santos, Marcello Univ., Campinas, Brazil). An. Acad. Brisil. Cienc., 39: Suppl., 17-38(Dec. 31, 1967). (In Spanish).
From Symposium on Peaceful Uses of Atomic Radiation, Rio de Janeiro, Brazil. See CONF-670709.

A review is given of the development of nuclear energy. The discovery of nuclear fission is first reported, and then the principal fuel cycles are summarized. The present energy needs and the calculated future energy needs of the world are indicated and the necessity for a new source of energy for Brazil is shown. An economic comparison is made between nuclear energy and hydroelectric energy in Brazil. The possibilities offered by nuclear fusion as an energy source are briefly mentioned. (J.S.R.)

33353 DIRECT SEARCH ALGORITHM FOR OPTIMIZING FUEL LOADING PATTERNS IN PWR'S. Naft, Barry N.; Sesonske, Alexander (Purdue Univ., Lafayette, Ind.). Trans. Amer. Nucl. Soc.; 13: 40-1(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33354 GENERAL SURVEY OF THE FRENCH FAST REACTOR PROGRAM. Vendryes, G. (CEA, Gif-sur-Yvette, France). Trans. Amer. Nucl. Soc.; 13: 104(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33355 IN-SERVICE INSPECTION OF LOOP SYSTEM SODIUM-COOLED FAST REACTOR. Pickett, A. G.; Hawkesworth, W. (Southwest Research Inst., San Antonio). Trans. Amer. Nucl. Soc.; 13: 120(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33356 FAST REACTOR ASSESSMENT STUDY. Ekholm, R. (Aktiebolaget Atomenergi, Stockholm); Hannerz, K.; Jirlow, K.; Unneberg, L. Trans. Amer. Nucl. Soc.; 13: 234-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33357 PERFORMANCE OF THE EBR-II REACTOR AT 62.5 MW(TH). Cushman, R. A. (Argonne National Lab., Idaho Falls, Idaho); Hyndman, R. W.; Long, J. K.; Miller, L. B. Trans. Amer. Nucl. Soc.; 13: 359-60(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33358 PLANT PERFORMANCE OF EBR-II AT 62.5 MW(TH). Buschman, H. W.; Koenig, J. F.; Perry, W. H. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 13: 360-1(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33359 IN-CORE FUEL MANAGEMENT OPTIMIZATION. Fulford, P. J.; Sesonske, Alexander (Purdue Univ., Lafayette, Ind.). Nucl. News; 13: No. 7, 58-62(Jul 1970).

Optimization techniques for reactor fuel element cycle management are presented. Search methods for determining optimum cycle management procedures are described. (6 references) (D.C.C.)

Safety and Siting

33360 (AI-AEC-12947) LMFBR SAFETY PROGRAMS. Quarterly Technical Progress Report, January–March 1970. (Atomics International, Canoga Park, Calif.). 15 May 1970. Contract AT(04-3)-701. 50p. Dep. CFSTI.

AEROSOLS—production of, effects of liquid sodium combustion in LMFBR environment on, (E/T)

LIQUID METAL FAST BREEDER REACTOR—safety programs during January to March 1970

REACTOR SAFETY—coolant boiling and combustion for LMFBR, test programs for liquid sodium, (E/T)

SODIUM—combustion of sprays of liquid, test programs for, (E/T)

—boiling of liquid, test programs for (D.C.C.)

33361 (DUN-SA-139) COMMERCIAL APPLICATION OF FAULT TREE ANALYSIS. Crosetti, P. A.; Bruce, R. A. (Douglas United Nuclear, Inc., Richland, Wash.). 7 Apr 1970. Contract AT(45-1)-1857. 41p. (CONF-700702-1). Dep. CFSTI.

From 9th Reliability and Maintainability Conference, Detroit, Mich.

Fault Tree Analysis is considered one of the more powerful analytical techniques applied within the aerospace industry to evaluate critical safety hazards. Fault trees provide a method of evaluating the systems operational risks of an undesirable outcome, where that undesirable outcome results from the system being in an unfavorable state, and while in that state, an unfavorable event occurs. The application of Fault Tree Analysis to evaluate system reliability and availability is discussed. It has provided an effective quantitative tool for evaluating the risks of simultaneous occurrence of two or more independent events which, in combination, are singularly undesirable. Experience in applying this technique to areas other than hazard analyses indicates that design and operational judgments are considerably strengthened, particularly on complex systems where the tradeoffs among several feasible alternatives may otherwise be highly subjective. The potential for general application of Fault Tree Analysis to commercial products appears attractive based not only on the successful extension from the aerospace safety technology to the nuclear reactor reliability and availability technology, but also because combinatorial hazards are common to commercial operations and therefore lend themselves readily to evaluation by Fault Tree Analysis. It is concluded that the technique has application within the commercial industrial community where the occurrence of a specified consequence or final event would be of sufficient concern to management to justify such a rigorous analysis as an aid to decision making. (8 references) (auth)

33362 (IN-1382) LOSS-OF-COOLANT ACCIDENT ANALYSIS PROGRAM. Technical Description. (Idaho Nuclear Corp., Idaho Falls). Jun 1970. Contract AT(10-1)-1230. 49p. Dep. CFSTI.

The Loss-of-Coolant Accident Analysis Program provides experimentally-verified analytical techniques for the Loss-of-Fluid Test (LOFT) Program and for the evaluation of light-water power reactors during a loss-of-coolant accident. The principal features of the Loss-of-Coolant Analysis Program include core thermal models, primary loop hydraulic models, structural models, and containment models. Included is a description of the purpose, objectives, and justification of the Loss-of-Coolant Accident Analysis Program as well as the relationship to other nuclear safety programs. The models developed, the work which has been accomplished on each of these models to the present time, and the computer codes which employ these models are also described. The computer codes include MOXY, THETA1, RELAP3, STRAP, and CONTEMPT-PS. A time schedule and work plan are also included for future development of these models. (39 references) (auth)

33363 (IN-1383) TECHNICAL ASSISTANCE IN REACTOR SAFETY ANALYSIS. Haire, J. C.; Brockett, G. F. (Idaho Nuclear Corp., Idaho Falls). May 1970. Contract AT(10-1)-1230. 34p. Dep. CFSTI.

The scope of the reactor safety program includes: (a) application of analytical models for determining reactor system behavior and evaluating engineered safety system performance under loss-of-coolant accident (LOCA) conditions for commercial nuclear power plants of current or advanced design and (b) assessment of these analytical models by comparing calculated results with experimental data. Work is currently directed toward five major interrelated facets of the loss-of-coolant accident: (1) analysis of subcooled blowdown phenomena, (2) analysis of ECC performance, (3) analysis of saturated blowdown phenomena, (4) analysis of containment response, and (5) analysis of structural response. (30 references) (auth)

33364 (JAERI-1054) SAFETY EVALUATION OF LIGHT WATER MODERATED POWER REACTOR. Togo, Yasumasa (Japan Atomic Energy Research Inst., Tokai. Tokai Research Establishment). 1964. 182p. (In Japanese). Dep. CFSTI (U. S. Sales Only).

Important problems associated with safety evaluation are reviewed. In contrast to "absolute safety," the concept of "social safety" is explained and factors to compose "social safety" are evaluated. Some comments are made on the philosophy of safety evaluation. Core spray and enclosure spray systems, which are essential with respect to safety evaluation of the maximum credible accident of light-water-moderated power reactors, are analyzed in detail. In evaluation of a core spray system, a detailed analysis is made on a loss-of-coolant accident, and effects of core spray system design (spray initiation time, spray flow rate, spray distribution, etc.) on fission product release are quantitatively clarified. In evaluation of an enclosure spray system, various fission product release reduction factors are calculated and the relative importance of an enclosure spray system is discussed. A hypothetical accident is analyzed. (auth)

33365 (ORNL-TM-3009) SUMMARY OF ENVIRONMENTAL INFORMATION ACTIVITIES OF THE NUCLEAR SAFETY INFORMATION CENTER. Cottrell, Wm. B.; Buchanan, J. R. (Oak Ridge National Lab., Tenn.). Jun 1970. Contract W-7405-eng-26. 72p. Dep. CFSTI.

In order to provide vital information for the SEQUIP Committee (Study of Environmental Quality Information Programs sponsored by the Federal Government), the relevant activities of the Nuclear Safety Information Center are summarized. In so doing the scope and modus operandi of this sophisticated, widely diversified and computerized scientific information and analysis center are also outlined. Involved are over 30 scientists (avg halftime) and an expanding information base approaching 12,000 documents annually—approximately one-third of which (both men and documents) are concerned with environmental information. The resources, sources, operation, and services provided are discussed together with a commentary on all aspects of the Center's activities. (auth)

33366 SAFETY RESEARCH FOR NUCLEAR REACTIVITY ACCIDENTS. Ishikawa, Michio (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi; 12: 276-83(1970). (In Japanese).

Research activities on nuclear reactivity accidents are discussed, and a program for increasing nuclear safety is examined. Destructive test results are described to afford a general concept of reactivity accidents. The SPERT-CDC experiments are cited as a new form of research program to gain a more detailed and clear insight into the accident behavior. The relationship between excursion power, fuel rupture and destructive energy is also discussed. Attention is drawn to the increasing importance of reactivity accident analyses for advanced type reactors, such as large light water power reactors. Reactivity accident programs by pulse reactors such as CDC, PBF, TREAT and NSRR (Japan) are reviewed. Finally an outline of the NSRR program is given. 37 references. (auth)

33367 EXPERIMENTAL STUDY OF BEHAVIOR OF VAPORIZED METAL IN LIQUIDS FOR ANALYSIS OF POST-MELTDOWN ACCIDENT PHENOMENON IN REACTOR VESSEL. Kondo, Shunsuke; An, Shigehiro; Imai, Tetsu (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 7: 248-55(May 1970).

Small pieces of lead and stainless steel were vaporized by electrical heating in water or oil contained in a cylindrical tank of 800 cm^3 capacity. The transient pressure behavior, impulse

to the top of the tank, and the relation between the voltage gradient and the arc discharge current in the metal vapor were measured. From analyses of these data, heat conduction around the vapor bubble was shown to be the probable mode of heat transfer at the bubble boundary. The pressure behavior at the tank wall is explained qualitatively. The electrical discharge method is shown to be a practical and useful means of simulating the post-meltdown phenomena in fast reactors. 12 references. (auth)

33368 DYNAMIC ANALYSIS OF NUCLEAR POWER PLANT BEHAVIOR TO SEISMIC EXCITATION. Plichon, C. E. (Electricite de France, Clamart). Nucl. Eng. Design; 12: 55-68 (May 1970).

A method for studying the behavior of a nuclear plant or any other structure submitted to an earthquake excitation is presented. The method used is called the "direct method" because the structure is at first cut into several rigid bodies which have the same total mass and which are attached to each other and to a rigid soil by shear and rotational springs and dampers. The springs are calculated in such a manner that the static deflection of the model and that of the real plant are both equal. The model is obviously able to take the same deflections or mode shapes as the real plant. Then dynamic equations are set up and solved by the Runge and Kutta Method giving the time history response of each part of the system to the acceleration of soil. Applications of this method have been made to two nuclear power plants, St. Laurent des Eaux and Phenix fast reactor. 7 references. (auth)

33369 ZIRCALOY-4 SINGLE- AND MULTIPLE-TUBE TEMPERATURE EXCURSION TESTS. Brett, J. M.; Papazoglou, T. P. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 13: 149-50(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33370 MEASUREMENT OF LWR COOLANT CHANNEL REDUCTION ARISING FROM CLADDING DEFORMATION DURING A LOSS-OF-COOLANT ACCIDENT. Waddell, R. D. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 150-1 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33371 APPLICATION OF EXPERIMENTAL DATA TO ANALYTICAL EVALUATION OF CLADDING FAILURE DISTRIBUTION. Lowe, A. L. Jr.; Bingham, B. E. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 13: 152-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33372 BEHAVIOR OF SIMULATED FUEL RODS IN A DEPRESSURIZATION LOSS-OF-COOLANT ACCIDENT (LOCA). Lawson, C. G. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 154-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33373 EFFECTS OF CLAD SWELLING ON EMERGENCY CORE COOLING PERFORMANCE. Carbiener, Wayne A. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc.; 13: 155-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33374 EFFECT OF FUEL ROD FAILURES ON BWR CORE-SPRAY STANDBY COOLING PERFORMANCE. Bock, R. G.; Duncan, J. D.; Leonard, J. E. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc.; 13: 156-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33375 EFFECT OF FUEL ROD FAILURE ON EMERGENCY CORE COOLING SYSTEM DESIGN FOR BWR'S. Hench, J. E.; Liffengren, D. J. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc.; 13: 157-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33376 EXPERIMENTAL STUDIES OF THE EFFECT OF FLOW RESTRICTIONS IN A SMALL ROD BUNDLE UNDER EMERGENCY CORE COOLANT INJECTION CONDITIONS. Davis, P. R. (Idaho Nuclear Corp., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 13: 158(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33377 EFFECT OF FLOW BLOCKAGE ON BOTTOM COOLING HEAT TRANSFER EFFECTIVENESS (FLECHT). Cermak, J. O.; Leyse, R. H.; Dominicis, D. P. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 158-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33378 HEAT TRANSFER BEHAVIOR FOR FLOW BLOCKAGE OF A FUEL ROD. Cermak, J. O.; Kitzes, A. S.; Tong, L. S. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 159-61(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33379 POST-LOCA HYDROGEN GENERATION IN PWR CONTAINMENTS. Bell, M. J.; Fletcher, W. D.; Marchese, R. T.; Gallagher, J. L. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 203-4(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33380 NUCLEAR SAFETY CRITERIA FOR THE DESIGN OF STATIONARY PRESSURIZED-WATER REACTOR PLANTS. Moore, J. S. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 214-15(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33381 NUCLEAR SAFETY CRITERIA FOR THE DESIGN OF STATIONARY PRESSURIZED-WATER REACTOR PLANTS: SYSTEM DESIGN CRITERIA. Owen, W. H. (Duke Power Co., Charlotte, N. C.). Trans. Amer. Nucl. Soc.; 13: 215(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33382 ENVIRONMENTAL RADIATION FROM PRESSURIZED WATER REACTORS. Wright, James H. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 221(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33383 FUNCTIONAL TESTING OF ENGINEERED SAFETY SYSTEMS. Buoni, F. B.; Kurstedt, H. A. Jr.; Morris, W. T. (Ohio State Univ., Columbus). Trans. Amer. Nucl. Soc.; 13: 240-1(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33384 LEVEL DISTRIBUTION OF COUNT RATE METERS FOR VARIOUS CIRCUIT PARAMETERS NOT GIVING GAUSSIAN DISTRIBUTIONS. Corwin, W. C.; Porges, K. G.; Daly, R. T. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 241-2(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33385 PROTECTION AGAINST LMFBR LOCAL CORE ACCIDENTS. van Erp, J. B.; MacFarlane, D. R.; Fauske, H. K. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 363-4(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33386 PIN-TO-PIN FUEL FAILURE PROPAGATION IN LMFBR. Khan, E. U. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 13: 364(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33387 COUPLED NEUTRONIC-HYDRODYNAMIC FAST REACTOR DISASSEMBLY ANALYSIS. Sha, W. T.; Hughes, T. H. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 365(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33388 EFFECT OF CORE-ZONING ON ENERGY RELEASE IN A FAST REACTOR DISASSEMBLY TRANSIENT. Lee, John C.; Pigford, Thomas H. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 13: 366(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33389 MARS MODIFICATION. Flanagan, George F. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 366-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33390 CALCULATION OF THE THERMODYNAMIC EFFICIENCY OF MOLTEN-FUEL-COOLANT INTERACTIONS. Judd, A. M. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.: 13: 369-70(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33391 NEW COMPUTATIONAL SYSTEM FOR FAST REACTOR ACCIDENT INVESTIGATION. Waltar, Alan E. (Battelle-Northwest, Richland, Wash.); Sha, William T. Trans. Amer. Nucl. Soc.: 13: 371(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33392 ANALYSIS OF A SLUG EXPULSION FOR A NON-METALLIC FLUID. Ford, W. D. (Argonne National Lab., Ill.); Fauske, H. K.; Bankoff, S. G. Trans. Amer. Nucl. Soc.; 13: 372(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33393 NONUNIFORM SODIUM SLUG EJECTION FROM AN ASYMMETRICALLY HEATED CHANNEL. Singer, Ralph M.; Holtz, Robert E.; Niemoth, Hubert R.; Moses, Ralph J. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.: 13: 373(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33394 STRUCTURAL ANALYSIS OF SUBASSEMBLY FUEL DUCTS. Krajcinovic, Dusan (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 374(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33395 CORRELATION OF PLASTIC RESPONSE OF TUBES TO GENERAL PRESSURE PULSES. Youngdahl, C. K.; Rosenberg, G. S. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 374-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33396 TRANSIENT ANALYSIS OF FUEL-SODIUM INTERACTION. Padilla, Andrew Jr. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 375-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33397 FAST REACTOR FUEL INTERACTIONS WITH CONCRETE AFTER A HYPOTHETICAL CORE MELTDOWN. Jansen, G.; Stepnewski, D. D.; Finch, L. M. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 376(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33398 DESIGN BASIS ACCIDENT EFFECTS ON REACTOR VESSEL COVER DESIGN. Fox, G. L. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 376-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33399 SAFETY ANALYSIS OF THERMAL FATIGUE DUE TO INTERMITTENT PASSAGE OF GAS BUBBLES THROUGH LMFBR CORE. Carelli, M. D.; Shoua, E. D. (Westinghouse Electric Corp., Madison, Pa.). Trans. Amer. Nucl. Soc.; 13: 377-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33400 MOLTEN MATERIAL-COOLANT INTERACTIONS. Cho, Dae H.; Armstrong, Donn R.; Gunther, William H. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 385(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33401 BLODWN-2 CODE PREDICTION OF PRESSURE UNDERSHOOT DURING TRANSITION FROM SUBCOOLED TO SATURATED BLOWDOWN. Fabic, Stanislav (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.: 13: 386-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33402 SIMPLIFIED COOLANT EXPULSION MODEL. Anderson, R. P.; Zaleski, P. L. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 388(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33403 ANALYTICAL INVESTIGATION OF REACTOR BARREL RESPONSE TO BLOWDOWN PRESSURE. Steck, Elmar; Bohm, George J. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 389(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33404 SEVERE REACTIVITY TRANSIENTS IN BOILING WATER REACTORS. Buckman, F. W. (Consumers Power Co., Jackson, Mich.); Lanning, D. D.; Thompson, T. J. Trans. Amer. Nucl. Soc.; 13: 389-90(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Power Conversion Systems

33405 HYDROGEN MONITOR FOR DETECTING LEAKS IN LMFBR STEAM GENERATORS. Vissers, D. R.; Holmes, J. T.; Nelson, P. A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 96-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Research and Test Reactors

Refer also to abstracts 31530, 31578, 31639, 33078, 33177, 33233, 33249, and 33465.

33406 (BNWL-325) FAST FLUX TEST FACILITY. Summary Technical Report, January–December 1966. Cabell, C. P. (comp.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jun 1970. Contract AT(45-1)-1830. 91p. Dep. CFSTI.

FAST FLUX TEST FACILITY—design and development during January to December 1966
FAST TEST REACTOR—design and development during January to December 1966
—heat exchangers for, dynamic digital computer simulation of
—cooling system for, computer simulation of
—control system of, development of instrumentation for
—core for, design specifications of conceptual
—in-pile loops for, development and testing of
—fuels for, irradiation testing of
—fuel element cladding for, testing of stainless steel
—core physics for, (E/T)
—fuel elements for, design parameters of Type 304 stainless steel clad plutonium oxide (PuO_2)–uranium oxide (UO_2) (D.C.C.)

33407 (BNWL-1059) SAFETY ANALYSIS PROGRAM. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 13 Feb 1969. Contract AT(45-1)-1830. 58p. Dep. CFSTI.

The objectives and activities of the safety analysis program for the FFTF are defined. Assigned responsibilities related to the safety analysis program are described. (D.C.C.)

33408 (DOCKET-50200-1) BABCOCK AND WILCOX TEST REACTOR. License TR-4; Twelfth Report to Division of Reactor Licensing, USAEC. (Babcock and Wilcox Co., Lynchburg, Va. Reseacrch and Development Div.). May 1970. 18p. (BAW-385). Dep. CFSTI.

Operations and maintenance requirements are described for October 1969 to March 1970. (D.C.C.)

33409 (GA-9946) FAST REACTOR SPECTRUM MEASUREMENTS. Technical Summary Report, February 1, 1969–January 31, 1970. Young, J. C.; d'Oultremont, P.; Neill, J. M. (Gulf General Atomic, Inc., San Diego, Calif.). 27 Feb 1970. Contract AT(04-3)-167. 107p. Dep. CFSTI.

The use of the Subcritical Time-of-Flight Spectral Facility (STSF) for the measurement of neutron spectra, neutron dieaway, and fission ratios in fast subcritical assemblies driven by the Gulf General Atomic 45-MeV LINAC is reported. Four cores have been studied extensively. Two of the cores (STSF-2 and STSF-2A) were simple, single-zone assemblies similar to ZPR-3 Assembly 17. Time-of-flight spectral investigations and ground work for two-parameter studies (time-of-flight vs pulse height) were performed in STSF-2, while a test of the kinetics codes used in data reduction was investigated in STSF-2A. Comparisons of the spectral data taken in STSF-2 with calculations performed using the 1DF code were satisfactory over most of the energy

range studied. Extensive studies of the spectra in the central zones of STSF-5 and -6 were also performed. These two cores are similar to ZPR-9 assembly 11 with STSF-6 having a Na void in the central region. Comparisons of these data with calculations did not show the degree of agreement as STSF-2, but this is not surprising considering the added complexity of the multizone system. In conjunction with these studies, auxiliary measurements were performed to study problems directly pertinent to the time-of-flight techniques. Re-entrant hole perturbations were studied in STSF-2 and it was concluded that the size of the re-entrant tube used was not a problem in the present studies. Perturbation of the spectra due to the spatial distributions of the source neutrons was investigated and it appears that this effect is not sufficient to remove the discrepancies present between measurements and calculations. The Li-glass detector was re-calibrated to extend the energy range of overlap between that detector and the NE-213. Two-parameter data were taken in one of the cores studied, STSF-5, after much preliminary studies of response functions and development of data reduction codes. The electron beam transport system from the LINAC was modified to enhance the amount of beam transferable to the target and to improve the methods used for piping the LINAC beam to the assembly. 10 references. (auth)

33410 (LFEN-NI-44-a) CALCULATION OF THE NEUTRON FLUX IN SUBCRITICAL ARRAYS. Jorge, H. Machado; Salgado, J. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1969. 19p. (In Portuguese). Dep. CFSTI (U. S. Sales Only).

The computer program DIFNE was used to calculate the fast and thermal neutron flux in the axial, radial, and azimuthal directions in a cylindrical subcritical assembly. The two-region assembly considered is semi-multiplying, with $k_\infty < 1$, without a reflector, and is set on a cylindrical graphite moderator. The fundamental theory is presented, physical characteristics and neutronic parameters of the assembly are given, and the results of the flux distribution calculations are analyzed. 5 references. (H.D.R.)

33411 DOPPLER COEFFICIENT MEASUREMENTS IN FCA. Yasuno, Takehiko; Nakano, Masafumi; Mukaiyama, Takehiko; Iijima, Tsutomu; Hirota, Jitsuya (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 7: 271-3(May 1970).

In the JAERI Fast Critical Facility (FCA), Doppler measurements were carried out with changes brought to reactivity by heating the sample. The Doppler equipment, the procedure of measurements, the results obtained with Assembly III-1, and a comparison of the results with calculations are described. 10 references. (auth)

33412 PULSE NEUTRON DECAY IN HEAVY-WATER SPHERES. Dorning, J.; Ginsberg, A. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng.; 41: 138-40(Jul 1970).

The discrete, fundamental-mode prompt-neutron decay constant, determined experimentally from pulsed-neutron measurements, has been calculated over a broad range of system sizes for spherical heavy-water assemblies. The discrete S_n method was used via the ANISN code for the transport calculations. Scattering by the bound deuterium atoms was represented by the Nelkin model (an incoherent scattering model). The code GAKER was used for the Nelkin model calculations. The oxygen was treated as a mass-16 free gas scatterer. Separate calculations were also done with the vapor frequencies replaced by the liquid frequencies. (12 references) (auth)

33413 DESIGN, CONSTRUCTION, AND EVALUATION OF AN LMFBR BLANKET TEST FACILITY. Forbes, I. A. (Massachusetts Inst. of Tech., Cambridge); Driscoll, M. J.; Thompson, T. J.; Kaplan, I.; Lanning, D. D. Trans. Amer. Nucl. Soc.; 13: 88(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33414 β_{eff} MEASUREMENTS IN TWO FAST REACTOR CRITICAL ASSEMBLIES. Carpenter, S. G.; Gasidlo, J. M.; Stevenson, J. M. (Argonne National Lab., Idaho Falls, Idaho). Trans. . Amer. Nucl. Soc.; 13: 92-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33415 COMPARISON OF MEASURED AND CALCULATED NULL COMPOSITIONS, CENTRAL REACTION RATIOS, AND REACTIVITY WORTHS IN ZPR-9 ASSEMBLIES 24 AND 25 AND ZPR-3 ASSEMBLY 55. LeSage, L. G.; Till, C. E.; Stanford, G. S. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 93(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33416 FUEL ROD FAILURE UNDER LOSS-OF-COOLANT CONDITIONS IN TREAT. Lorenz, R. A.; Hobson, D. O.; Parker, G. W. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 152(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33417 FORMULATION OF HIGH-ORDER PERTURBATION THEORY FOR CRITICAL SYSTEMS. Travelli, A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 186-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33418 MONTE CARLO EIGENVALUE CALCULATIONS OF FAST CRITICAL ASSEMBLIES USING VIM-1. Levitt, Leo B.; Lewis, R. C. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 194-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33419 SPRAY PROGRAM AT THE NUCLEAR SAFETY PILOT PLANT. Parsly, L. F. Jr. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc.; 13: 209(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33420 REMOVAL OF IODINE FORMS BY SPRAYS IN THE CSE CONTAINMENT VESSEL. Hilliard, R. K.; Coleman, L. F. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 210-11(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33421 REMOVAL OF AEROSOL PARTICLES BY SPRAYS IN THE CSE CONTAINMENT VESSEL. Postma, A. K.; McCormack, J. D. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 211-12(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33422 ANOMALIES IN ARGONAUT REACTOR COMPONENT PERFORMANCE. Englehart, Richard W.; Dalton, G. R. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 13: 229-30 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33423 HIGH-TEMPERATURE LATTICE TEST REACTOR OPERATION TO 1000^{0}C. Clark, R. G. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 230(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33424 SYSTEM FOR COMPUTER CONTROL OF PROMPT-CRITICAL TRANSIENTS IN TREAT. Larsen, G. R.; Boland, J. F. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 13: 238-9(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33425 MTR-PHOENIX FUEL CRITICAL EXPERIMENTS AND ANALYSIS. Kutcher, J. W.; Davis, E. C.; Heeb, C. M. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 245-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

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From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33430 NEUTRON SPECTRUM MEASUREMENTS IN ECEL REACTOR CORES 17, 17P, AND 18. Paschall, R. K. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc.; 13: 267(Jun-Jul 1970).
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From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33434 POSTANALYTICAL STUDY OF EIGHT ZPR-3 BENCHMARK CRITICALS USING ENDF/B DATA. Hess, A. L.; Palmer, R. G.; Stevenson, J. M. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 13: 288-9(Jun-Jul 1970).
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From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

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33442 INVERSE MULTIPLICATION MONITORING OF SUBCRITICAL REACTIVITY CHANGES IN FTR. Engstrom, S. L.; Bennett, R. A.; Uotinen, V. O. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 325-6(Jun-Jul 1970).
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33443 SIZE DISTRIBUTION OF BUBBLES EMITTED FROM SIMULATED CLADDING BREAKS. Anderson, R. P.; Bova, L.; Roop, J. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 328-9(Jun-Jul 1970).
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33445 FFTF SODIUM-TO-AIR DUMP HEAT EXCHANGER DIGITAL SIMULATION. Madsen, R. N. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 340-1(Jun-Jul 1970).
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33446 SUPPRESSION OF SODIUM SLUG IMPACTS IN THE TREAT MARK-II LOOP. Deitrich, L. W. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 341-2(Jun-Jul 1970).
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33447 NOTES ON THE USE OF THE "ENGINEERING MOCKUP" AS A NUCLEAR DESIGN TOOL. Bennett, R. A.; Engstrom, S. L.; Nelson, J. V.; Hofmann, P. L. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 353(Jun-Jul 1970).
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33449 NEUTRON FILTER FOR TREAT SAFETY STUDIES ON FAST REACTOR FUEL. Rothman, A. B.; Dickerman, C. E.; Dewey, G. G.; Barts, E. W. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 356-7(Jun-Jul 1970).
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33450 FIRST TREAT EXPERIMENT ON HIGH-ENERGY FUEL FAILURE OF AN UNIRRADIATED OXIDE FAST REACTOR FUEL PIN IN FLOWING SODIUM. Dickerman, C. E. (Argonne National Lab., Ill.); Robinson, L. E.; Boland, J. F.; Purviance, R.; Schmidt, K. Trans. Amer. Nucl. Soc.; 13: 370-1(Jun-Jul 1970).
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33451 CRITICALITY OF U(3.85) RODS AND CYLINDRICAL ANNULI IN WATER. Johnson, E. B. (Union Carbide Corp., Oak Ridge, Tenn.). Trans. Amer. Nucl. Soc.; 13: 379(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33452 CRITICAL EXPERIMENTS WITH HOMOGENEOUS PuO_2. Bierman, S. R.; Clayton, E. D. (Battelle-Northwest, Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 379-80(Jun-Jul 1970).
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33453 MINIMUM CRITICAL MASS OF ^{235}U REFLECTED BY NATURAL URANIUM IN WATER. Gray, A. W.; Jones, L. L. Jr. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 382-3(Jun-Jul 1970).
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From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

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From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33456 DOSIMETRY MEASUREMENTS AT THE WHITE SANDS MISSILE RANGE FAST BURST REACTOR (WSMR-FBR). Welch, D. L.; Luera, T. F. (White Sands Missile Range, N. Mex.). Trans. Amer. Nucl. Soc.; 13: 433-4(Jun-Jul 1970).
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Rocket and Space Reactors

Refer also to abstract 33233.

33457 IRRADIATION RESULTS FOR REFRACTORY METAL CERMET FUELS OF 710 REACTOR SYSTEM. Collins, J. F.; Newsom, D. L. (General Electric Co., Cincinnati). Trans. Amer. Nucl. Soc.; 13: 1-2(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

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33459 EVALUATION OF GRAPHITE FUELS FOR SPACE ELECTRIC POWER SYSTEMS. Boman, L. H.; Tobin, J. M. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33460 MODELING OF THERMIONIC REACTOR SYSTEMS FOR DYNAMIC STUDIES. Guppy, James G. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 13: 8(Jun-Jul 1970).
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33461 STABILITY ANALYSIS FOR A MODERATED IN-CORE THERMIONIC REACTOR. Hatzilau, I. K.; Emendoerfer, D. (Univ., Stuttgart). Trans. Amer. Nucl. Soc.; 13: 8-9(Jun-Jul 1970).
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33464 CALCULATED NEUTRON ENVIRONMENT FOR PHOEBUS 2A. Watson, Clayton W. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 13: 11-12(Jun-Jul 1970).
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33465 COMPARISON OF EXPERIMENTALLY MEASURED AND CALCULATED RADIATION ENVIRONMENT INTERNAL TO THE PAX R-1 REACTOR. Hill, D. J.; Rankin, W. D. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 13: 12-13(Jun-Jul 1970).
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33466 EFFECTS OF NUCLEAR STAGE TANK GEOMETRY ON PAYLOAD RADIATION PROTECTION REQUIREMENTS. Billings, M. P.; Goetz, C. A. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). Trans. Amer. Nucl. Soc.; 13: 13(Jun-Jul 1970).
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33467 MONTE CARLO RADIANT HEAT TRANSFER ANALYSIS OF GAS CORE REACTORS. Williams, J. R.; Byrn, N. R.; Clement, J. D.; Jacobs, W. R. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 13: 13-15(Jun-Jul 1970).
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33468 EVALUATION OF CRITICAL MASS FOR OPEN-CYCLE, GAS-CORE ROCKET REACTOR. Hyland, Robert E. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 13: 15-16(Jun-Jul 1970).
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33469 RADIANT HEAT TRANSFER PARAMETERS OF HIGH-TEMPERATURE HIGH-PRESSURE AEROSOLS. Williams, J. R.; Partain, W. L.; Clement, J. D. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 13: 345-6(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33470 ESTIMATES OF FUEL CONTAINMENT IN A GAS-CORE NUCLEAR ROCKET. Putre, Henry A. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 13: 346-7(Jun-Jul 1970).
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33471 CREW RADIATION DOSE FROM A GAS-CORE NUCLEAR ROCKET PLUME. Masser, Charles C. (Lewis Research Center, Cleveland). Trans. Amer. Nucl. Soc.; 13: 415-16(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33472 ESTIMATION OF SPATIAL DISTRIBUTIONS OF NEUTRON CAPTURES IN RESONANCE ABSORBERS. Bogart, Donald (Lewis Research Center, Cleveland). Nucl. Sci. Eng.; 41: 37-46(Jul 1970).

The problem of precise calculation of spatial distributions of capture in resonance absorbers is crucial to the design of layered shields. Errors in spatial distribution of capture occur in multigroup neutron-transport calculations because of the necessarily broad energy groups employed. The single average-capture cross section in each group results in large underestimates of the capture rates near surfaces of resonance absorbers. Consequently, the spatial-capture gamma-ray generation and escape fraction are also in error. A method is presented for computing spatial-resonance-capture rates in thick layers. It employs group-effective resonance integrals to precalculate group-effective resonance cross sections that are universal functions of distance into the absorptive layer. The method is illustrated for captures in ^{238}U for the energy region 0.5 eV to 100 keV. The method is applied to a spherical reactor-shield configuration that contains alternate layers of depleted uranium and lithium hydride. Detailed comparison is made of the results of a discrete ordinates multigroup calculation with those of the present method. The comparison shows that the difference in spatial-capture distribution of the S_n broad treatment of resonance capture causes the capture gamma-ray dose to be always underestimated. For example, the difference in spatial-capture distribution in a 7-cm slab of ^{238}U causes the leakage dose to be a factor of 2 smaller than that obtained with the present method. The apparent generality of the present method suggests that it may be applied directly to the results of layered shield calculations made by S_n broad-group methods. Application of the method to the experimental variation of epicadmium capture with depth from the surface of metallic-uranium rods up to 5 cm in diameter as measured by Hellstrand provided spatial capture rates that agreed with experiment very well. (auth)

Process Heat and Desalination Reactors

33473 (NP-18234) STUDY OF WATER PLANT ISOLATION FROM CONTAMINATION. Research and Development Progress Report No. 526. Crever, Frederick E. (National Nuclear Corp.,

Palo Alto, Calif.). Oct 1969. Contract No. 14-01-0001-2192. 147p. GPO $1.50.

The potential concentration of radioactive nuclides in the water plant brine, effluent, and product water for dual purpose power generation and desalting plants using nuclear steam supply systems is analyzed. The nuclear steam supply systems considered were those using water cooled and moderated reactors. The design basis for a pressurized demineralized water loop to be inserted between the heating steam from a nuclear steam supply and the brine in a multi-stage flash seawater desalting plant is described. The purpose of the isolating loop is to allow extended operation at full capacity with brine heater leakage. The design basis is also presented for an isolating loop using steam as the working fluid between the nuclear steam supply and a multi-stage flash seawater distillation plant. 15 references. (D.C.C.)

33474 METHODOLOGICAL ASPECTS OF TECHNICO-ECONOMIC PARAMETERS OF NUCLEAR DESALINATION PLANTS. Koryakin, Yu. I.; Loginov, A. A.; Chernyaev, V. A. (Government Committee on the Utilization of Nuclear Energy, Moscow). Desalination; 7: 323-42(Apr 1970).

The methodology used in calculating the optimum design parameters for dual-purpose desalination and power reactor plants is presented. Topics discussed include: basic directives for costing computations; comparison criteria for economic feasibility and distribution of total evaluated expenditure; distribution of total production expenditure and determination of cost of electricity, heat, and distillate; review of production costs distribution methods; and comparison of the different methods. 6 references. (D.C.C.)

33475 LARGE REACTORS FOR POWER AND WATER DESALTING. Ma, Benjamin M. (Iowa State Univ., Ames). Nucl. Eng. Design; 12: 9-17(May 1970).

The current and the near-term thermal converters and the long-range fast breeders for seawater desalination are analyzed based on the fundamental principles, present technology and future development of nuclear reactors. By using the available data of light-water reactors, the trends of current and near-term thermal converters and long-range fast breeders are predicted and discussed. The unit plant cost, and the total nuclear power cost (consisting mainly of the fixed charge, the fuel cycle cost and the operating, maintenance cost) versus the cumulative and the net plant capacity (or reactor size) are respectively shown by curves. The first and the equilibrium core costs and the plant thermal efficiency versus the cumulative plant capacity are illustrated. The comparison of water cost versus net plant capacity and plant load factor for the single-purpose and the multipurpose nuclear desalting plants are also given. The feasibility and development of nuclear agro-industrial complexes and the vertical tube evaporators for desalting seawater technology are briefly discussed. 10 references. (auth)

33476 OPTIMAL ALLOCATION OF ENERGY IN INDUSTRIAL AND AGRO-INDUSTRIAL COMPLEXES USING DYNAMIC PROGRAMMING. Bouchey, G. D.; Koen, B. V.; Beightler, C. S. (Univ. of Texas, Austin). Nucl. Sci. Eng.; 41: 70-8(Jul 1970).

The application of dynamic programming algorithms to the optimal allocation of energy in large nuclear-powered complexes is presented. The formulation and solution of the problem of optimal product mixes in both purely industrial and agro-industrial complexes is discussed. Simplified numerical examples of each case are presented to illustrate the solution method. (10 references) (auth)

Marine and Portable Power Reactors

33477 (HIT-3775-3) PM-3A TYPE 4 CORE ANALYSIS: COMPARISON OF MEASURED AND CALCULATED DATA AND DATA FOR THE TEST MANUAL. (Hittman Associates, Inc., Columbia, Md.). Apr 1970. Contract AT(30-1)-3775. 32p. (HIT-445). Dep. CFSTI.

A comparison of the Zero Power Experiment (ZPE) measured data and the final design calculations for the PM Type 4 cores are presented. The Test Data Manual curves, revised to reflect the ZPE results and a limited set of calculations performed after the ZPE data were obtained, are also presented. ZPE measurements were performed on two cores of the Type 4 design by two different facilities. The Core II experiments were more complete and were the primary source of ZPE data reported. The measurements on both cores were performed with several different numbers of removable burnable poison elements replacing the removable fuel elements in the cores. The final design calculations were all performed with 24 removable fuel elements and no removable burnable poison elements inserted in the core. In the preparation of the Test Data Manual curves, the calculated data have been modified, where necessary, to account for the presence of removable burnable poison elements in place of the removable fuel elements. (8 references) (auth)

33478 TRAINING OF SHIPS PERSONNEL FOR THE NS OTTO HAHN. Oldag, H. Ch. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Atomwirt., Atomtech.; 15: 238-9(May 1970). (In German).

The first commercial nuclear powered ship in Europe, the NS Otto Hahn, is utilized to train naval engineers for handling nuclear powered ships. The training program consists of two major parts, a theoretical and a practical one. The theoretical section, comprising 284 hours, is conducted at a nuclear center because of better teaching personnel and learning facilities. An outline of this section is tabulated as to nuclear theory, reactor construction, radiation protection, and chemical monitoring of the reactor. Following the theoretical preparation, 16 weeks of on board training are conducted. In the future, an abbreviated course of 4 to 6 weeks is planned for captains and navigators. (H.B.G.)

33479 CALCULATIONS AND MEASUREMENTS OF THE NUCLEAR CHARACTERISTICS OF N. S. SAVANNAH SHUFFLED CORE I. Robbins, T. R. (Packard, Lowe and Associates, Washington, D. C.); Kim, Y. S.; Smith, J. A. Trans. Amer. Nucl. Soc.: 13: 249-50(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Production Reactors

33480 ^{236}U AND ^{237}Np BUILDUP DATA FROM GRAPHITE-MODERATED REACTORS. Toffer, H. (Douglas United Nuclear, Inc., Richland, Wash.). Trans. Amer. Nucl. Soc.; 13: 65-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Reactor Theory

33481 STABILITY ANALYSIS OF A NONLINEAR REACTOR CONTROL SYSTEM. Chen, Y. L. (Chiao Tung Univ., Hsinchu, Taiwan); Han, K. W. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; 17: No. 2, 18-25(Apr 1970).

A method for testing control system stability is presented, which is useful for finding the limit cycles of high order systems with multiple nonlinearities. The presented method is applied to the analysis of the control system of a material testing reactor. (4 references) (auth)

Kinetics

Refer also to abstracts 33098, 33102, 33241, 33251, 33279, 33412, 33417, and 33418.

33482 (BNWL-1396) DBUFIT-I: A LEAST SQUARES ANALYSIS CODE FOR NUCLEAR BURNUP DATA. Matsen, R. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1970. Contract AT(45-1)-1830. 63p. Dep. CFSTI.

The computer code, DBUFIT-I, is designed to extract integral cross section information from isotopic burnup data. This information is obtained by fitting burnup equations to the isotopic data using least squares fitting techniques. The burnup equations applicable to Pu and U-Pu fuels are described. The application of the code is illustrated by a sample burnup problem. 6 references. (auth)

33483 (GAMD-10007) BRITL: A FUEL ROD ANALYTICAL MODEL FOR THERMAL OR FAST FLUX IRRADIATIONS. Thompson, W. I. (Gulf General Atomic, Inc., San Diego, Calif.). 1 Apr 1970. Contract AT(04-3)-167. 32p. Dep. CFSTI.

The BRITL computer program was developed to study interactions between fuel and cladding in cylindrical oxide fuel elements under the action of either a thermal or fast neutron flux. The program allows for initial cracking to relieve thermal tensile stresses resulting from the high internal temperature gradients. 7 references. (D.C.C.)

33484 (KFK–1088) THE SATURN CODE: A THEORETICAL ANALYSIS OF FUEL PIN BEHAVIOR AND FUEL VOID DYNAMICS. Kaempf, H.; Karsten, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Nov 1969. 42p. (EURFNR–755). Dep. CFSTI (U. S. Sales Only).

The SATURN-Code, swell and thermal analysis under reactor conditions, contains a macroscopic modelling analysis of the thermal and mechanical effects of the different types of void volumes. The thermal effects of the porosity, central void and open gas gap are analyzed. A new relation for the porosity dependence of the thermal conductivity is deduced. For given gas contents and determined ranges of pore temperatures and sizes a simple approximate equation results. Central void is very effective in reducing the central temperature; making use of it means increasing the linear rod power. The in-pile migration of the porosity in the hotter regions of oxide fuel forms resp. increases the central void and densifies the hotter region. This effect is calculated by a two-zone porosity model. For the open ideal gap fuel-clad filled with inert gases and mixtures of He with fission product gas mixtures the temperature drop is calculated as a function of gap width, linear rod power, clad inside temperature and clad inside radius. The interaction behavior and burnup behavior are also analyzed. The problem is partitioned concerning weak and strong contact interaction. The weak contact interaction is realized if cracks caused by thermal expansion are existent. A way is described to treat the gas-swelling and the stress strain state of the swelling crack-free fuel in contact with the clad. For the case of a hollow cylindrical fuel a two-zone model consisting of the fuel and the clad is used with a strong axial friction force in the interface. For the solid cylindrical fuel a three-zone model consisting of two fuel zones is proposed. While a strong axial friction force is assumed between the outer fuel zone and the clad, this friction force is neglected between the two fuel zones. 34 references. (auth)

33485 (LA–4432) THEORY AND USE OF THE GENERAL-GEOMETRY TWOTRAN PROGRAM. Lathrop, K. D.; Brinkley, F. W. (Los Alamos Scientific Lab., N. Mex.). Apr 1970. Contract W-7405-eng-36. 80p. Dep. CFSTI.

Finite difference equations are derived for the Boltzmann transport equation in (x,y) rectangular, (r,θ) cylindrical, and (r,z) cylindrical geometries. These equations are shown to be consistent with the analytic forms of the transport equation, and when used with the arithmetic mean difference assumption, to have second-order truncation error. The TWOTRAN program to solve the multigroup approximation to the transport equation using these difference equations is described. The theory of a coarse-mesh rebalancing procedure which accelerates all the iterative processes of the program is derived. Detailed input and usage instructions for the program are given, including flow charts of the major subroutines. Functional descriptions of the major sweeps through the space-angle mesh are provided. A sample problem is described. 11 references. (auth)

33486 (RLO–2058-1) MODAL METHODS FOR COMPUTING FAST REACTOR SPECTRA. Annual Progress Report. Robinson, Alan H. (Oregon State Univ., Corvallis. Radiation Center). 15 Nov 1969. Contract AT(45-1)-2058. 14p. Dep. CFSTI.

A modal method of representing neutron spectra in fast reactors is presented for two dimensional diffusion theory calculations. The method is applied to a 1000 MW(e) fast reactor design and the EBR-2 core. (D.C.C.)

33487 (RLO–2058-2) MODAL METHODS FOR COMPUTING FAST REACTOR SPECTRA. Lorenzini, Paul G. (Oregon State Univ., Corvallis). 1 Nov 1969. Contract AT(45-1)-2058. 161p. Dep. CFSTI.

Thesis.

A modal method of representing neutron spectra in fast reactors is presented for two dimensional diffusion theory calculations. The method is applied to a 1000 MW(e) fast reactor design and the EBR-2 core. 53 references. (D.C.C.)

33488 (WAPD-T-2346) CALCULATION OF NEUTRON SLOWING DOWN PROPERTIES IN THORIUM–WATER LATTICES. Swaja, R. E. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar 1970. Contract AT-11-1-GEN-14. 12p. (CONF-700608–2). Dep. CFSTI.

From American Nuclear Society Meeting, Los Angeles, Calif.

As a test of the reliability of nuclear data used to analyze thorium bearing reactors, a comparison was made between calculated and experimentally determined neutron slowing down properties as measured in ThO_2–H_2O–D_2O lattices. The two principle quantities of interest are the "age" of the fission neutrons and the variation of net saturated acti[illegible] with source-detector separation. (auth)

33489 VOPROSY TEPLOFIZIKI YADERNYKH REAKTOROV. VYPUSK 2. (Problems in Thermal Physics of Nuclear Reactors. Number 2). Petrovichev, V. I. (ed.). Moscow; Atomizdat (1969). 136p.

Fourteen articles are included on theoretical investigations related to hydrodynamics and thermodynamics for one- and two-phase flow in channels of various geometric forms in nuclear reactors. Local characteristics of isothermal two-phase flow, mechanism of steam transformation, the rate of bubble formation, and critical boiling in channels are analyzed. Heat exchange in longitudinal streamlining of fuel rods and the influence of secondary flow on the hydrodynamics of the fluid flow in non-spherical channels are discussed. A new dilatometric method for measuring the coolant coefficient is described. Methods for measuring and calculating heat transfer at high temperatures are also described. 4 references. (R.V.J.)

33490 STUDY ON THE DYNAMIC BEHAVIOR OF THE COUPLED NUCLEAR REACTOR BY NODAL APPROXIMATION. Furuichi, Kenji; Ebizuka, Yoshie (Tokyo Inst. of Tech.). Nippon Genshiryoku Gakkaishi; 12: 242-54(1970). (In Japanese).

Much attention has been paid to the dynamic behavior of coupled reactors since the design of modular reactors was proposed from the viewpoint of safety. However, very little appears to have been achieved in presenting a unified approach to contribute to a better understanding of such reactor systems. An attempt to derive nodal kinetic equations from multi-group diffusion equations, taking into account the spatial and spectral coupling effects, is presented. The numerical solutions to these nodal kinetic equations are compared with those to the one group-one dimensional diffusion equations, and discussions are presented on the validity of the equations derived and on the time dependence of the kinetic parameters relevant to the change of the neutron flux shape. 25 references. (auth)

33491 FAST REACTOR SPACE–ENERGY SYNTHESIS. Neuhold, Robert Jack. Lafayette, Ind.; Purdue Univ. (1969). 152p.

Thesis.

The space-energy synthesis approach is improved by employing a more general weight function in deriving the synthesis equation system, by the use of more appropriate trial functions, and by deriving a more general analytical solution for the synthesized equations. Synthesis results using optimum trial functions from a spatial diffusion calculation or real trial functions from zero dimensional calculations showed that reaction rate weighting generally provides substantially more accurate results than the commonly used trial function weighting (Galerkin method). Adjoint weighting also provided accurate results but requires additional calculations as contrasted to reaction rate weighting. Although the best results are obtained using different reaction rate weight functions for different integral quantities, the core fission reaction rate is good for general application. With such weighting, the % deviation from the correct solution can be reduced by as much as a factor of 4 for the eigenvalue, a factor of 2 for the blanket-to-total fission ratio and a factor of 4 for the blanket-to-total absorption ratio. The precise improvement depends on core size. (Diss. Abstr.)

33492 OPTIMUM PRINCIPLE IN HYDRAULIC MAPPING OF NUCLEAR REACTORS. Klemin, A. I.; Kochenov, I. S.; Strigulin, M. M. This paper was summarized in At. Energ. (USSR); 27: 217(Sep 1969) as paper No. 335/5314. (In Russian).

Disadvantages of widely used hydraulic mapping principles are analyzed. A hydraulic mapping method, based on the principle of the maximum index of thermal performance reliability is outlined. This principle suggests that all core channels will be operating under normal thermal conditions at maximum probability. (4 references) (D.C.D.)

33493 STABILITY OF A LARGE CIRCULATING-FUEL REACTOR. Goryachenko, V. D. This paper was summarized in At. Energ. (USSR); 26: 279(Mar 1969) as paper No. 262. (In Russian).

Equations related to stability limits for steady-state operation of large circulating-fuel reactors are presented. (3 references) (D.C.C.)

33494 PERTURBATION-THEORY CALCULATION OF THE REACTOR LOSS COEFFICIENT. Stepanov, A. V. This paper was summarized in At. Energ. (USSR); 26: 281(Mar 1969) as paper No. 265. (In Russian).

Approximate analytical expressions are obtained for physics parameters of heterogeneous reactors. The expressions represent values averaged over the thermal neutron flux. (D.C.C.)

33495 OSCILLATORY MODES IN NUCLEAR REACTORS. Gorbunov, V. P.; Kryanev, A. V.; Shikhov, S. B. This paper was

summarized in At. Energ. (USSR); 27: 48(Jul 1969) as paper No. 313/4866. (In Russian).

Requirements for the existence of a periodic oscillatory mode in reactor operations are presented. An algorithm for calculating the periodic oscillatory mode is derived. (D.C.C.)

33496 INVESTIGATION OF TWO-REGION SYSTEMS BY PULSED NEUTRON METHOD. Stumbur, E. A.; Matveenko, I. P.; Kolosov, B. I. This paper was summarized in At. Energ. (USSR); 27: 215(Sep 1969) as paper No. 333/5050. (In Russian).

Formulas are presented giving elementary approximate solutions for neutron flux distributions in reactors with varying thickness reflectors. Calculated values are compared with experimental distributions. 6 references. (D.C.C.)

33497 STATIONARY MODES OF REACTOR HEAT REMOVAL WITH THE AID OF NATURAL CIRCULATION. Bagdasarov, Yu. E.; Levshin, E. P.; Leonchuk, V. N. This paper was summarized in At. Energ. (USSR); 138-9(Aug 1969) as paper No. 324/5129. (In Russian).

A method is described for calculating the stationary modes of natural circulation in multichannel nuclear reactors with single-phase coolant and heat exchangers which are distributed over the height of the reactor. By using successive approximations to calculate the temperature field in the heat exchangers, the problem reduces to finding the difference in heights between heat exchanger centers. At least 2 or 3 approximations are required for accuracy. (D.C.C.)

33498 SPACE–TIME OPTIMIZED REACTOR PROBLEMS. Rudik, A. P. This paper was summarized in At. Energ. (USSR); 27: 138(Aug 1969) as paper No. 323/4934. (In Russian).

The space–time optimization problem in which the phase variables depend both on the space argument and on the time is analyzed. The minimized functional has the form of a double integral of the specified function with respect to space and time. The control is also a function of the two variables. The general method is illustrated by an example which involves finding the optimum transition of an iodine well when the reactor power is reduced. 15 references. (D.C.C.)

33499 NUMERICAL METHOD FOR THE SOLUTION OF THREE-DIMENSIONAL NEUTRON-TRANSPORT PROBLEMS. Wagner, M. R. (Gulf General Atomic Europe, Zurich); Sargis, D. A.; Cohen, S. C. Nucl. Sci. Eng.; 41: 14-21(Jul 1970).

A low-order discrete ordinates model for the solution of a certain class of three-dimensional neutron-transport problems is described. The method can be applied to cuboidal configurations with a region structure that allows the use of constant mesh spacings in each of the three coordinate directions. The angular flux distribution in a unit mesh cell is described in terms of discrete directions connecting the midpoints of 14 neighbor cells. A three-dimensional multigroup discrete ordinates code 3DT has been written for x, y, z-geometry which allows calculation of various configurations for small critical assemblies with computing speed far surpassing Monte Carlo techniques. The computed results for individual fuel-block reactivity worths of the fast thermionic critical experiment of Gulf General Atomic are in most cases in excellent agreement with experiment. (7 references) (auth)

33500 BURNUP OPTIMIZATION OF CONTINUOUS SCATTERED REFUELING. Motoda, Hiroshi (Central Research Lab., Kawasaki, Japan). Nucl. Sci. Eng.; 41: 1-13(Jul 1970).

A variational treatment of the burnup optimization of continuous scattered refueling is presented and numerical solutions are given for a slab reactor. It is made quantitatively clear how the reactor dimension, the Ze and the Doppler feedback reactivity, the burnup dependence of fission cross section and the reflector performance affect the power distribution that maximizes the average discharge exposure. Power flattening and burnup maximization are contradictory in general, but are consistent if, and only if, the condition of the perfect reflection at the core boundary is satisfied. The optimal power distribution is peaked in the central—and depleted in the outer region; and becomes flatter as the reflector performance is increased. The maximum average burnup depends on the burnup dependence of fission cross section and the strength of the Doppler and the xenon feedback reactivity, even if the average burnup calculated by the point-reactor model is the same. The former effect on the optimal power distribution is very small but the latter effects greatly contribute to power flattening. Both effects reduce the maximum burnup and the effects of the latter two are of comparable order. As the reactor becomes smaller, the maximum burnup decreases almost linearly to the neutron leakage. Optimal refueling has an advantage of more than 10% in the average burnup over the conventional flat-refueling rate method. However the difference from the flat-burnup method is very small, considering that the optimal refueling is handicapped by its very bad power distribution. (11 references) (auth)

33501 STATE VARIABLE FEEDBACK AND SERIES COMPENSATION OF MULTIVARIABLE SYSTEMS. Slivinsky, Charles R. (Univ. of Missouri, Columbia); Schultz, Donald G.; Weaver, Lynn E. Nucl. Sci. Eng.; 41: 125-9(Jul 1970).

The basic state variable feedback design technique for reactor control systems having multiple inputs and multiple outputs is presented with the requirement of additional compensation to meet design criteria. (5 references) (D.C.C.)

33502 EXTRAPOLATION DISTANCES AND DIFFUSION PARAMETERS VIA PULSED-NEUTRON ANALYSIS. Dorning, J. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng.; 41: 22-8(Jul 1970).

Size-dependent extrapolation distances for pulsed-neutron experiments in light-water, spherical, non-multiplying systems have been determined by calculating the buckling in the B-1, 30-group approximation corresponding to a given decay constant. The decay constants for spheres of various radii were taken from an earlier work which reported 30-group S_n calculations of decay constants as a function of system radius. The same 30-group, B-1 method was also used to calculate pulsed-neutron-decay constants as a function of buckling over a wide range of buckling. The static or poisoning experiment inverse-relaxation length, as a function of concentration of a one-over-ν poison, was also computed in the same approximation. The resulting data were combined and fitted to yield values of the neutron-diffusion parameters. (17 references) (auth)

33503 NUCLEAR ENGINEERING FOR UNIVERSITY FRESHMEN. Nelson, George W. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 13: 24(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33504 EVALUATION OF AN INTRODUCTORY NUCLEAR ENGINEERING COURSE TAUGHT BY A SELF-PACED METHOD. Koen, Billy V. (Univ. of Texas, Austin). Trans. Amer. Nucl. Soc.; 13: 24-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33505 DESIGN DECISION ANALYSIS OF NUCLEAR POWER SYSTEMS. Fazzolare, Rocco A. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 13: 25-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33506 SYNTHETIC KERNEL METHOD FOR EVALUATION OF GROUP CROSS SECTIONS. Waelti, Paul (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 170(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33507 ANALYTIC APPROXIMATION TO THE DOPPLER-BROADENED LINE SHAPE. Goldstein, Rubin (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 13: 171 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33508 CALCULATION OF NEUTRON TIME-ENERGY DISTRIBUTIONS FOLLOWING AN EPITHERMAL BURST. Nguyen, Dong H. (Naval Postgraduate School, Monterey, Calif.); Rodriguez, Pablo J. Trans. Amer. Nucl. Soc.; 13: 173-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33509 EXPLANATION OF BILINEAR PERTURBATION THEORY BY VARIATIONAL PRINCIPLE. Komata, Masaoki (Central Research Inst. of the Electric Power Industry, Tokyo). Trans. Amer. Nucl. Soc.; 13: 175-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33510 HYBRID SOLUTION OF SPACE- AND ENERGY-DEPENDENT REACTOR KINETICS. Schultz, K. R.; Bullock, T. E.; Ohanian, M. J. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 13: 176-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33511 EVALUATION OF FUNCTIONALS WITH DISCONTINUOUS TRIAL FUNCTIONS. Lambropoulos, P.; Luco, V.

(Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 178-9(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33512 STRONGLY IMPLICIT ITERATIVE PROCEDURE. Stone, Herbert L. (ESSO Production Research Co., Houston, Tex.). Trans. Amer. Nucl. Soc.; 13: 180(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33513 USE OF AN ARRAY PROCESSOR IN THE SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS. Johnson, Olin G. (IBM Houston Scientific Center, Tex.). Trans. Amer. Nucl. Soc.; 13: 181-2(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33514 COARSE MESH ACCELERATION OF ITERATIVE SOLUTION OF NEUTRON DIFFUSION EQUATION. Nakamura, S. (Ohio State Univ., Columbus). Trans. Amer. Nucl. Soc.; 13: 186(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33515 PRECISION METHOD FOR COMPUTING EIGENVALUES OF THE HELMHOLTZ EQUATION. Bolstad, John W.; Chambre, P. L. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 13: 188(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33516 TWO-OVERLAPPING-GROUP TRANSPORT APPROXIMATION FOR THERMAL-NEUTRON PROBLEMS. Natelson, M. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 189(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33517 GENERAL SOLUTION OF THE P_L APPROXIMATION TO THE MONOENERGETIC TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING. I. SLAB GEOMETRY. Canosa, Jose (IBM Scientific Center, Palo Alto, Calif.). Trans. Amer. Nucl. Soc.; 13: 190-1(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33518 GENERAL SOLUTION OF THE P_L APPROXIMATION TO THE MONOENERGETIC TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING. II. SPHERICAL GEOMETRY. Canosa, Jose (IBM Scientific Center, Palo Alto, Calif.). Trans. Amer. Nucl. Soc.; 13: 191-2(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33519 METHOD FOR COMBINING THE DIFFUSION AND THE INTEGRAL TRANSPORT EQUATIONS. Takahashi, Hiroshi (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 13: 192-3(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33520 ANISOTROPIC SOURCES IN TWO-DIMENSIONAL TRANSPORT THEORY. Friedman, Jack P.; Crawford, Bruce W. (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Amer. Nucl. Soc.; 13: 194(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33521 NEUTRON-CONSERVING RUSSIAN ROULETTE. Gast, R. C. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 195(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33522 ANGLE-DEPENDENT BIASING IN MONTE CARLO CALCULATIONS. Schmidt, F. A. R. (Univ., Stuttgart). Trans. Amer. Nucl. Soc.; 13: 196(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33523 TRUNCATION ERROR ANALYSIS OF FINITE DIFFERENCE APPROXIMATIONS TO THE TRANSPORT EQUATION. Reed, Wm. H.; Lathrop, K. D. (Los Alamos Scientific Lab., N. Mex.). Trans. Amer. Nucl. Soc.; 13: 196-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33524 CONVERGENCE OF INTEGRAL TRANSFORM METHOD IN MONOENERGETIC NEUTRON TRANSPORT THEORY. Boffi, V. C.; Molinari, V. G.; Premuda, F.; Trombetti, T. (CNEN, Bologna). Trans. Amer. Nucl. Soc.; 13: 197-8(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33525 TRANSPORT THEORY FOR MONOENERGETIC NEUTRONS IN FINITE CONVEX GEOMETRIES. Boffi, V. C.; Molinari, V. G.; Premuda, F.; Trombetti, T. (CNEN, Bologna). Trans. Amer. Nucl. Soc.; 13: 198-9(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33526 NEW DEFINITION OF COMPOSITE MODERATING PARAMETERS FOR THE GOERTZEL–GREULING CONTINUOUS SLOWING DOWN THEORY. Stacey, W. M. Jr. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 199-200(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33527 TRANSPORT THEORY FOR KINETIC MODELS VIA ANALYTIC CONTINUATION. Dorning, J. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 13: 200-1 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33528 DEVELOPMENT AND APPLICATION OF SINGLE-ELEMENT METHODS. Seth, S. S. (Massachusetts Inst. of Tech., Cambridge); Driscoll, M. J.; Thompson, T. J.; Kaplan, I. Trans. Amer. Nucl. Soc.; 13: 246-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33529 EFFECTS OF S/N RATIO ON THE RESULTS OF POLARITY CORRELATION EXPERIMENTS. Lehto, Wayne K.; Goin, R. W. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 13: 271(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33530 COMPARISON OF THE EXACT AND APPROXIMATE REACTOR NOISE PROBABILITY DISTRIBUTIONS. Szeless, Andreas; Ruby, Lawrence (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 13: 272(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33531 INFORMATION THEORY APPLIED TO REACTOR NOISE PROBLEMS. Albrecht, Robert W. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 13: 273(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33532 CONSISTENT SUBCRITICAL KINETICS AND ITS IMPLICATIONS TO REACTIVITY TECHNIQUES. Gozani, T. (Gulf General Atomic Inc., San Diego, Calif.). Trans. Amer. Nucl. Soc.; 13: 274-5(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33533 PSEUDO MODES OF A MODEL THERMAL SYSTEM. Yan, C. C.; Papazoglou, T.; Corngold, N. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc.; 13: 276-7(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33534 SEPARATION AND CONTINUATION IN THE PULSED-NEUTRON EXPERIMENT. Corngold, N.; Yan, C. C. (California Inst. of Tech., Pasadena). Trans. Amer. Nucl. Soc.; 13: 277 (Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33535 FURTHER EXPERIENCE WITH IMPLICIT TIME-DIFFERENCING METHODS FOR TWO-DIMENSIONAL REACTOR KINETICS. Rhyne, W. R. (Babcock and Wilcox Co., Lynchburg, Va.). Trans. Amer. Nucl. Soc.; 13: 281(Jun-Jul 1970).
From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33536 EVALUATION OF PUBLISHED DELAYED-NEUTRON PARAMETERS FOR ^{235}U AND $^{235}U + D_2O$ SYSTEMS. Church, J. P. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc.; 13: 283(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33537 DETERMINATION OF TEMPERATURE COEFFICIENTS IN A NONLINEAR SPACE-DEPENDENT REACTOR SYSTEM. Roman, W. S.; Hsu, C.; Habegger, L. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc.; 13: 284-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33538 CALCULATION OF NEUTRON SLOWING DOWN PROPERTIES IN THORIUM–WATER LATTICES. Swaja, R. E. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 304-5(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33539 COMPARISON OF APPROXIMATE RESONANCE TREATMENTS FOR LIGHT-WATER-MODERATED SYSTEMS. Meyer, Philip E.; Zweifel, P. F. (Edlund-Shure-Zweifel, Ann Arbor, Mich.). Trans. Amer. Nucl. Soc.; 13: 305-6(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33540 ANALYSIS OF HEAVY- AND LIGHT-WATER-MODERATED THERMAL REACTOR LATTICES USING ENDF/B DATA. Rothenstein, W. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc.; 13: 324(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33541 BASIC THEORY AND CONCEPTS. Honeck, H. C. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Amer. Nucl. Soc.; 13: 391(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33542 LEGENDRE MOMENTS OF THE ELASTIC-SCATTERING CROSS SECTION FOR S-WAVE NEUTRONS. Grimesey, R. A. (Idaho Nuclear Corp., Idaho Falls); Serrano, W.; Dannels, R. A. Nucl. Sci. Eng.; 41: 140-3(Jul 1970).

A number of computer codes are currently in use which calculate elastic-scattering transfer matrices for use in P_N and S_N multigroup reactor codes. The numerical integrations performed in these codes are based on a familiar equation for the Legendre moments of the elastic-scattering transfer matrix in the laboratory coordinate system. Application of the equation for reliable numerical results is described. (7 references) (auth)

33543 STOCHASTIC STABILITY OF A REACTOR WITH LINEAR FEEDBACK. Dudziak, Donald J. (Los Alamos Scientific Lab., N. Mex.). Nucl. Sci. Eng.; 41: 129-38(Jul 1970).

Some intrinsic properties of stability as they pertain to stochastic reactor models are discussed. (14 references) (auth)

Dynamics

Refer also to abstracts 33245, 33460, and 33461.

33544 (ANL–7626) HYBRID SIMULATIONS OF ENERGY- AND SPACE-DEPENDENT CORE DYNAMICS. Carter, J. C.; Morehouse, N. F.; Amiot, L. W.; Maletich, F. J. (Argonne National Lab., Ill.). Feb 1970. Contract W-31-109-eng-38. 37p. Dep. CFSTI.

A small and relatively slow hybrid computer has been assembled for the purpose of gaining experience and evaluating the potential of simulating large mathematical models of reactor systems. The first simulation presented is a model consisting of the two-group, space- and time-dependent neutron-diffusion equations with delayed groups, two-dimensional heat transfer in each of three core regions, and reactivity feedbacks from each region due to Doppler effect and changes in the physical properties of fuel and coolant. The cylindrical volume of a 1000 MW(e) fast reactor is divided into five radial increments and six axial increments. Coupling between radial and axial increments is by heat flow and neutron diffusion. The solution over the volume of the core is achieved by multiplexing equations and by using iterative techniques. The equations are written to define average values of variables within the volume of each increment of the cylindrical core. At each axial increment, the reactivity feedback resulting from a forced variation of an energy-, space-, and time-dependent variable, such as the fission cross section in a given geometric increment, is calculated and stored in the computer memory. The exit values of the variables from the first axial increment become the initial value to the second axial increment, and so on until the volume of the core is covered. The calculation is repeated until convergence is achieved. The responses of the model to perturbations of time-dependent variables in a given energy group or space mode are presented and analyzed. These perturbations are in the form of impulses, steps, ramps, and oscillations in the neutron production or in any other variable in the equations comprising the model of the reactor system. (auth)

Experimental Applications

Refer also to abstract 33243.

33545 (BAW-3647-16) PHYSICS VERIFICATION PROGRAM. PART III. TASKS 2 AND 3. Final Report. Baldwin, M. N.; Fairburn, G. T.; Mason, R. C.; Pettus, W. G.; Stern, M. E. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Apr 1970. Contract AT(30-1)-3647. 178p. Dep. CFSTI.

In October of 1968, Part III, Task 2 of the Physics Verification Program was initiated. Objectives were: (1) To generate detailed experimental power-profile data suitable for verifying the accuracy of three-dimensional computer codes; and (2) to correlate power profile data with the signals generated by an all-solid in-core detector string. Task 3 was initiated in January of 1969. The objectives of this task were to construct and license a facility for PCTR type measurements on plutonium lattices, to verify the proposed procedures by measurements on a conventional UO_2 lattice, and to obtain measurements of k_∞ and other parameters for several plutonium-bearing lattices. All of the experimental results obtained during Part III, Tasks 2 and 3 of the program are summarized. (auth)

33546 ON-LINE PREPARATION OF INPUT MODULES FOR COMPLEX COMPUTER PROGRAMS. Goodrich, J. M.; Connolly, T. J. (Stanford Univ., Calif.). Trans. Amer. Nucl. Soc.; 13: 26-7(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33547 MECHANISMS FOR THE RELEASE OF FISSION GAS FROM OPERATING OXIDE FUEL RODS. Nichols, F. A.; Warner, H. R. (Westinghouse Electric Corp., West Mifflin, Pa.). Trans. Amer. Nucl. Soc.; 13: 130-1(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33548 HOLE PERTURBATION EFFECTS ON FAST-NEUTRON SPECTRA IN BULK MEDIA. Kaushal, N. N.; Malaviya, B. K.; Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc.; 13: 252-3(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33549 TESTING OF HETEROGENEITY METHODS USED IN FAST REACTOR CRITICAL ANALYSES BY COMPARISON WITH THEORETICAL (GEDANKEN) EXPERIMENTS. Palmer, R. G.; Plummer, J. P.; Nicholson, R. B. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc.; 13: 253(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33550 ANALYZER RECYCLING BETWEEN NEUTRON BURSTS USING GOZANI'S PULSED-NEUTRON TECHNIQUE. Chow, R. H. (California State Coll., Long Beach). Trans. Amer. Nucl. Soc.; 13: 273-4(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33551 TIME AND SPACE DEPENDENCE OF NEUTRON FLUX IN LARGE SINGLE CAVITIES. Nelson, George W.; Forehand, Harry M.; Aissji, Abdul Wahid (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 13: 277-8(Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

33552 PULSED-ACTIVATION TECHNIQUE FOR THE STUDY OF DOPPLER EFFECTS. Lucoff, D. M.; Foell, W. K. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 13: 321 (Jun-Jul 1970).

From American Nuclear Society Meeting, Los Angeles, Calif. See CONF-700608.

Reactor Components, Fuels, and Accessories

Refer also to abstracts 31460, 31548, 31556, 31558, 31574, 31630, 31631, 31652, 31656, 32338, 32339, 32348, 32349, 32357–32359, 32375, and 32468.

33553 ACCURACY OF APPROXIMATIONS USED IN RESONANCE INTEGRAL CALCULATION. Mizuta, Hiroshi (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 7: 264-8(May 1970).

The accuracy of several approximations commonly used in resonance integral calculations is numerically investigated by use of the computer codes RICM and RICM-2. They are programmed with the intention of obtaining an exact value of the resonance integral by solving numerically the coupled neutron slowing down equations formulated in terms of collision probabilities. Four items are chosen for verification and the results are presented. 12 references. (auth)

33554 NUCLEAR FUEL ASSEMBLY. Gumuchian, A. Canadian Patent 837,300. 17 Mar 1970. Priority date 5 Dec 1966, France.

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